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SURVEILLANCE REPORT. STAGE I DISSECTED MOTORS. PHASE X. PROPELL--ETC(U)
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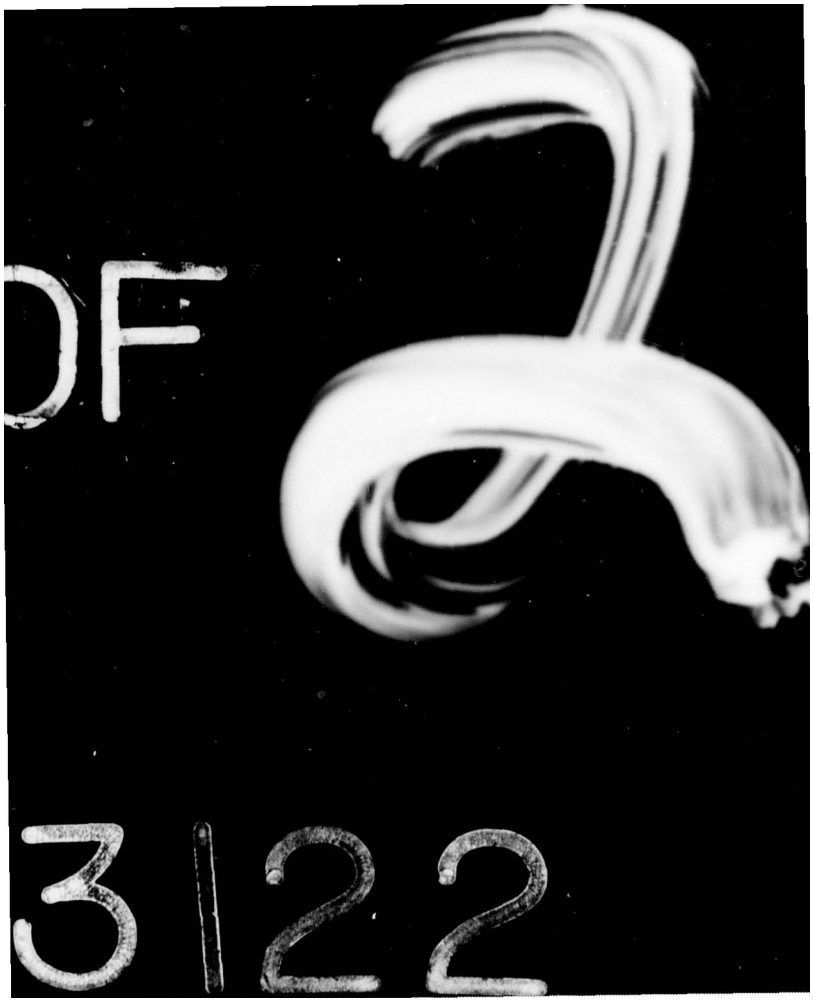
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HEADQUARTERS

OGDEN AIR LOGISTICS CENTER

UNITED STATES AIR FORCE

HILL AIR FORCE BASE, UTAH 84056

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SURVEILLANCE REPORT.
STAGE I
DISSECTED MOTORS.
PHASE X.

PROPELLANT AND COMPONENT TESTING.

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MMWRM PROJECT M82934C-WNL17514

SURVEILLANCE QUARTERLY REPORT

STAGE I DISSECTED MOTORS

PHASE X PROPELLANT & COMPONENT TESTING

Author

John A. Thompson

JOHN A. THOMPSON, Chemist
Component & Combustion Test Unit

Engineering & Statistical Review By

John K. Scambia

JOHN K. SCAMBIA, Project Engineer
Service Engineering

Edward J. Erickson

EDWARD J. ERICKSON, Statistician
Data Analysis Unit

Recommended Approval By

Ronald F. Larsen

RONALD F. LARSEN, Chief
Physical & Mechanical Test Unit

Leonidas A. Brown

LEONIDAS A. BROWN, Chief
Component & Combustion Test Unit

Approved By

Don F Woods

DON F. WOODS, Chief
Propellant Laboratory Section

Nov 1978

Industrial Products & Ldg Gear Division
Directorate of Maintenance
Ogden Air Logistics Center
United States Air Force
Hill Air Force Base, Utah 84056

ABSTRACT

Testing was performed to determine the useful shelf/service life for LGM-30 Stage I Rocket Motors. A three year storage program for propellant and components was started in May 1961. This program was then extended to a ten year study and later continued indefinitely to assure that a deterioration in motor physical characteristics could be detected in time to take some corrective actions before the weapon system performance deteriorated below an acceptable level.

This report covers only propellant data and limited case bond data. The malfunction of an environmental chamber destroyed component samples that had originally been part of this testing program (and the inadvertent burning of some motors during dissection reduced the material available for testing). Planned dissection of selected motors in the future will provide samples for continued component testing. Test specimens for this reporting period were obtained from motors STM-012, 0012099, 0012199 and UP7775 block propellant.

Separate analyses were made on the respective motors and block propellant for the second time in this report and are shown in the regressions. The plotting symbols for each motor and block propellant are listed in the statistical analyses section.

The data from this test period was combined with data from previous testing and entered into the G085 computer for storage, analysis, and regression analysis. From the statistical analysis of all data tested to date, significant degradation of the propellant does not appear likely for at least two years past the oldest data point.

Future testing will be conducted on dissected motors.

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GLOSSARY OF TERMS AND ABBREVIATIONS

Aging Trend	A change in properties or performance resulting from aging of material or component
CSA	Cross Sectional Area
DB	Dogbone
Degradation	Gradual deterioration of properties or performance
E	Modulus (psi), defined as stress divided by strain along the initial linear portion of the curve.
EB	End Bonded
EGL	Effective Gage Length
em	Strain at maximum stress
er	Strain at rupture
"F" ratio	The ratio of the variance accounted for by the regression function to the random unexplained variance. The regression function having the most significant "F" ratio is used for plotting data. The ratio is also used in detecting significant changes in random variation between succeeding time points
JANNAF	Joint Army, Navy, NASA, Air Force Committee
MANCP	Propellant Lab Section at Ogden Air Logistics Center
Ogden ALC	Ogden Air Logistics Center, Air Force Logistics Command
r or R	The Correlation Coefficient is a measure of the degree of closeness of the linear relationship between two variables
Regression Equation	The general form of the regression equation is $Y = a + bx$
Regression Line	Line representing mean test values with respect to time
S_b	Standard error of estimate of the regression coefficient

S_e or $S_{Y.X}$	Standard deviation of the data about the regression line
Sm	Maximum Stress
Sr	Stress at rupture
Standard Deviation (S_y)	Square root of variance
Strain Rate	Crosshead speed divided by the EGL
"t" test	A statistical test used to detect significant differences between a measured parameter and an expected value of the parameter (determines if regression slope differs from zero at the 95% confidence level)
Variance	The sum of squares of deviations of the test results from the mean of the series after division by one less than the total number of test results
3 Sigma Band	The area between the upper and lower 3 sigma limit. It can be expected that 99.73% of the inventory represented by the test samples would fall within this range assuming that the population is normally distributed.
90-90 Band	It can be stated with 90% confidence that 90% of the inventory represented by the test samples would fall within this range assuming that the population is normally distributed

INTRODUCTION

A. PURPOSE:

This report contains test data from samples of LGM-30 Stage I, Wings I-V TP-H1011 propellant and case bond specimens. Testing was performed by the Propellant Laboratory Section (MANCP) for the Engineering and Reliability Branch of the Airmunitions Management Division (MMWRM) under Project M82934C-WNL17514. This report is the tenth in this series. Data from this test period and propellant test data from the nine previous reports were entered into the G085 computer for regression analysis. The regressions are shown in this report.

B. TEST PROGRAM:

The LGM-30 Laboratory and Component Program includes the testing of materials used in the main case, aft closure, ignition assemblies, and main grain propellant. This report covers TP-H1011 propellant and case bond specimens. Table I outlines the test program.

Propellant for testing was obtained from three dissected motors, STM-012, a motor prepared by Thiokol specifically for dissection; S/N 0012099, A SLIM motor; Motor S/N 0012199 selected from the inventory for dissection; and UP-7775 block propellant.

C. HISTORICAL BACKGROUND:

In May 1961, Thiokol began a three year LGM-30 laboratory storage and test program to determine the rate of degradation with age for Stage I materials. During June 1962 and again in August 1963, additional samples were included. New samples were added in July and August 1964 when the

surveillance testing program was extended to ten years (Test Plan 0717-62-0967, 53-8). Carton block propellant, batch UP-7775, containing TP-H1011 propellant cast in March 1962 was added to the program in 1964.

Samples added to the inventory in 1964 were considered to be a new population, but were combined in regression analysis with the three dissected motors. The history of testing of these materials is found in MQQP Report Nrs. 109A(67), 144(68), 208(71), and MANCP Report 358(76). Physical transfer of the specimens from Thiokol to Ogden ALC was made in June 1967.

TABLE I

TEST PROGRAM

All Temperatures in Fahrenheit

STM-012, SN 0012099, SN 0012199, UP-7775

Test	Conditions	Spec/ Cond	Spec Conf
Tensile	77°, 2.0 & 20 in/min	5 ea	JANNAF Dogbone
Creep	77°, 10 & 12 lb load	3 ea	JANNAF Dogbone
Stress Relax	77°, 3 & 5% strain	3 ea	1/2" x 1/2" x 4"
Strain Dilatation	77°, .25 in/ in/min	3 ea	1/2" x 1/2" x 4"
Hardness	77°, initial & 10 sec	5 ea	Dogbone Ends
HOE	77°	3 ea	1/2" x 3/8" x 1"
Burning Rate	77", 500 & 1,000 psi	5 ea	.156" x .156" x 5"
DTA	77° start	3 ea	0.040" wafer
Ignitability	77°, 168 cal/ cm^2/sec	3 ea	0.050" wafer
Sol Gel	77°	6 ea	1/2" x 1/2" x 1/2"
UP 7775 will NOT be used on the following tests:			
High rate Tensile	77°, 1,000 in/in/min	5 ea	3/4" GL Dogbone
Triaxial High Rate	77°, 1,000 in/in/min 600 psi	3 ea	3/4" GL Rail
Dynamic Response	77°, 70 gm ct wt	3 ea	3.3" x .33" x 0.690" disc
Biaxial constant Strain	77°	3 ea	3/4" GL Rail

TABLE I (cont)

Test	Conditions	Spec/Cond	Spec Conf
Failure Envelope	Temp: -50° -20°, 10° 40°, 77° 130°, & 180°F at a rate of 0.2, 2.0, & 20 in/min	3 ea	JANNAF Dogbone
STM012 and 0012199 only will be for the following tests:			
Case Bond Tensile	77°, 0.2 in/ min	10 ea	1" x 5/8" x 3/4"
Tear Energy	77°F ± 2°	8 ea	0.1" x 1.18" x 3"
Poisson's Ratio (Strain Dilatation) 10, 15, 20 25, 30%	77°F ± 2°	6 per/ condition	0.50" x 0.50" x 4"

STATISTICAL ANALYSIS

The objective of this statistical analysis is to determine whether or not any aging trends are demonstrated by accumulated test data in order to assist Service Engineering to more accurately predict motor serviceability.

Propellant was made available for testing and statistical analysis to obtain an overall view of the aging trends affecting the First Stage Dissected Motor Program. The sampling consists of data from two dissected operational motors (0012099 and 0012199), and carton propellant (batch UP-7775). One motor (STM-012) was prepared by Thiokol specifically for the dissection program.

A Multi-symbol Regression Analysis Program was used to determine aging trends. The sampling is combined for each test parameter in a single regression analysis. The linear equation ($Y = a + bX$) was found to be the best fit model for the data in this report. A composite population aging trend line is then calculated accepting the fact that individual aging of different populations may be masked.

The Multi-symbol Program uses a unique plotting code for each motor and carton data on the regression plots. This method of data plotting allows a visual display of the overall relationship between the various origins of data and how they relate to the overall least square aging trend line.

The regression program uses an analysis with individual data points from different time periods combined to establish a least squares aging trend line for the overall data. The variance about the regression line, obtained using individual values of the dependent variable, was used to compute a tolerance interval such that at the 90% confidence level 90% of the population falls within this interval. This tolerance interval was

extrapolated to a maximum of 24 months to give an indication of the statistical significance of the slope of any aging trends. The computer tolerance interval about the composite regression line is wider than what the tolerance interval would be about any individual motor or carton regression line because of the increased data spread introduced by combining different populations of data. The "t" values and the significance of this statistic, which are reported for each regression model, gives an indication of the "statistical significance" of the slope of the aging trend in the Y-axis. Data and regression trend lines were plotted utilizing an IBM-360/65 computer.

ORIGIN SYMBOL TABLE

Origin	DOM	Wing	Symbol
Motor 0012099	63166	2	0
Motor 0012199	63227	2	1
Motor STM-012	61221	1	S
Carton UP-7775	62075	1	U

TEST RESULTS

Regression analysis is the method of evaluation used in the analysis of the test results.

A. TENSILE:

Low rate tensile test data shows a statistically significant gradual decrease for strain at maximum stress and strain at rupture. Maximum stress and stress at rupture do not show a significant change. The modulus shows a statistically significiant increase. (Figures 1 thru 5).

The 20/min low rate tensile test data shows a statistically significant decrease for the strain at maximum stress, strain at rupture and stress at rupture. Maximum stress and modulus do not show a significant change. (Figures 6 thru 10).

No significiant change is shown for the high rate regressions (Figures 11 thru 15).

High rate triaxial testing shows a statistically significant increase for the strains and stress at rupture with the maximum stress showing no significant change. Modulus shows a statistically significant decrease. (Figure 16 thru 20).

Case bond tensile data shows a statistically significant decrease (Figure 21). For this test period, 10 specimens were tested. The failure mode for 5 specimens was 100% adhesive, liner to propellant. Two specimens had 100% adhesive, case to liner failure. Data on three of the specimens was not used. Examination after testing showed up to

90% of the case bond surface area was rusty. The most probable cause for the rusty area would be damage to the case bond when the motor was dissected or when the specimens were machined. There is the possibility that the case was not prepared properly before the liner was applied.

B. CREEP:

For the 10 pound load test data the regressions show a statistically significant decrease, except for the 1000 sec regression which shows no significant change (Figure 22 thru 25).

For the 12 pound load a statistically significant decrease in creep compliance is shown for the 10 and 20 second regressions (Figures 26 and 27). The 1000 second and strain at rupture regressions do not show a significant change (Figures 28 and 29).

C. STRESS RELAXATION:

Stress relaxation modulus for both 3 and 5% strain shows no significant change (Figures 30 thru 37).

D. CONSTANT STRAIN:

A statistically significant decrease is shown for constant strain (Figure 38).

E. SHORE HARDNESS:

The Shore A ten second hardness shows no significant change (Figure 39).

F. BURNING RATE:

A statistically significant decrease is shown for both the 500 and 1,000 psi initial testing (Figures 40 and 41).

G. HEAT OF EXPLOSION:

The heat of explosion does not show a significant change (Figure 42).

H. IGNITABILITY:

No significant change is seen in the data by the regression (Figure 43).

I. DIFFERENTIAL THERMAL ANALYSIS (DTA):

The endotherm does not show a significant change (Figure 44). The exotherm shows a statistically significant decrease and the ignition temperature shows a statistically significant increase (Figures 45 and 46).

J. SOL GEL:

A statistically significant gradual decrease is shown for percent extractable wt. swell ratio, sol gel density, and cross link density (Figures 47 thru 50).

K. FAILURE ENVELOPE:

The failure envelope for motor S/N 0012099 is shown in Figure 51.

CONCLUSIONS

The test results show that, under present storage conditions, some of the physical/mechanical and combustion properties of the propellant indicate statistically significant aging trends. On some regressions where a significant trend is indicated, the slope of the trend line is quite gradual and no operational problems are expected. On other regressions, i.e., triaxial tensile and burning rate, the slope of the trend line appears quite steep although, in reality, the percent change is minor as indicated by the formulas found at the top of each figure. The Y-axis range is automatically varied by the data spread to provide visibility between individual data means. As a result, the range values (on Y-axis) must be considered when visually analyzing regression slopes.

Although some aging trends have been observed, it does not appear that any significant degredation will occur in the propellant within the next two years.

RECOMMENDATIONS

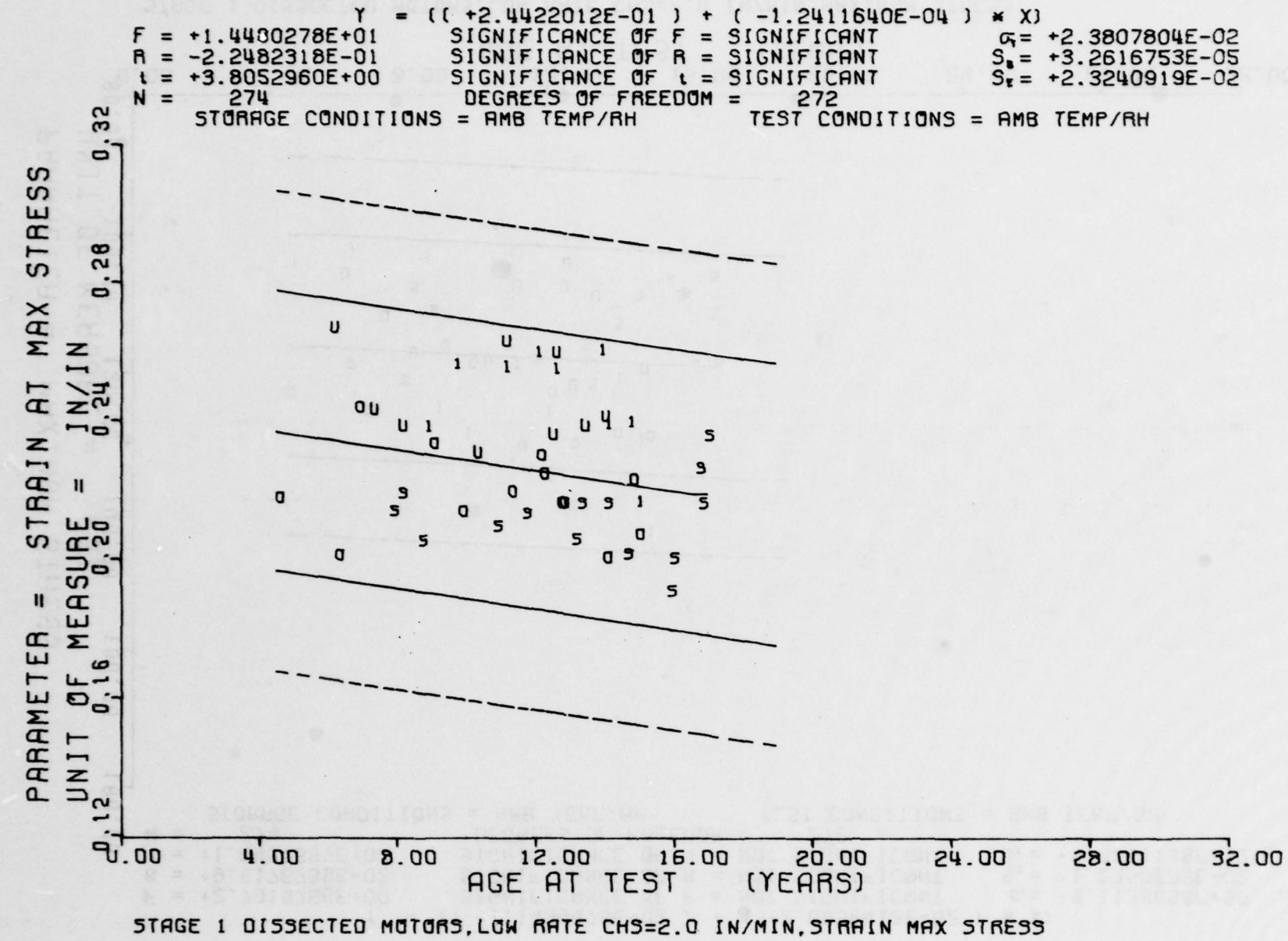
It is recommended that continued testing be conducted on the three dissected motors and UP-7775 block propellant presently being tested and also on those motors selected for testing by Service Engineering. On those motors selected for future dissection, testing will include propellant, casebond and component materials.

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES	AGE (MONTHS)	NR SAMPLES
54.0	26	159.0	24
73.0	24	160.0	5
75.0	2	166.0	5
82.0	5	167.0	5
87.0	5	168.0	16
94.0	16	175.0	8
97.0	7	176.0	3
104.0	5	177.0	5
106.0	5	179.0	8
108.0	5	190.0	3
116.0	5	191.0	5
118.0	5	200.0	3
123.0	4	201.0	3
130.0	5	203.0	5
133.0	15		
135.0	3		
140.0	5		
144.0	5		
145.0	3		
146.0	2		
149.0	3		
150.0	10		
152.0	3		
153.0	5		
157.0	3		

STAGE 1 DISSECTED MOTORS,LOW RATE CHS=2.0 IN/MIN,STRAIN MAX STRESS

This sample size summary is applicable to figures 1 thru 4.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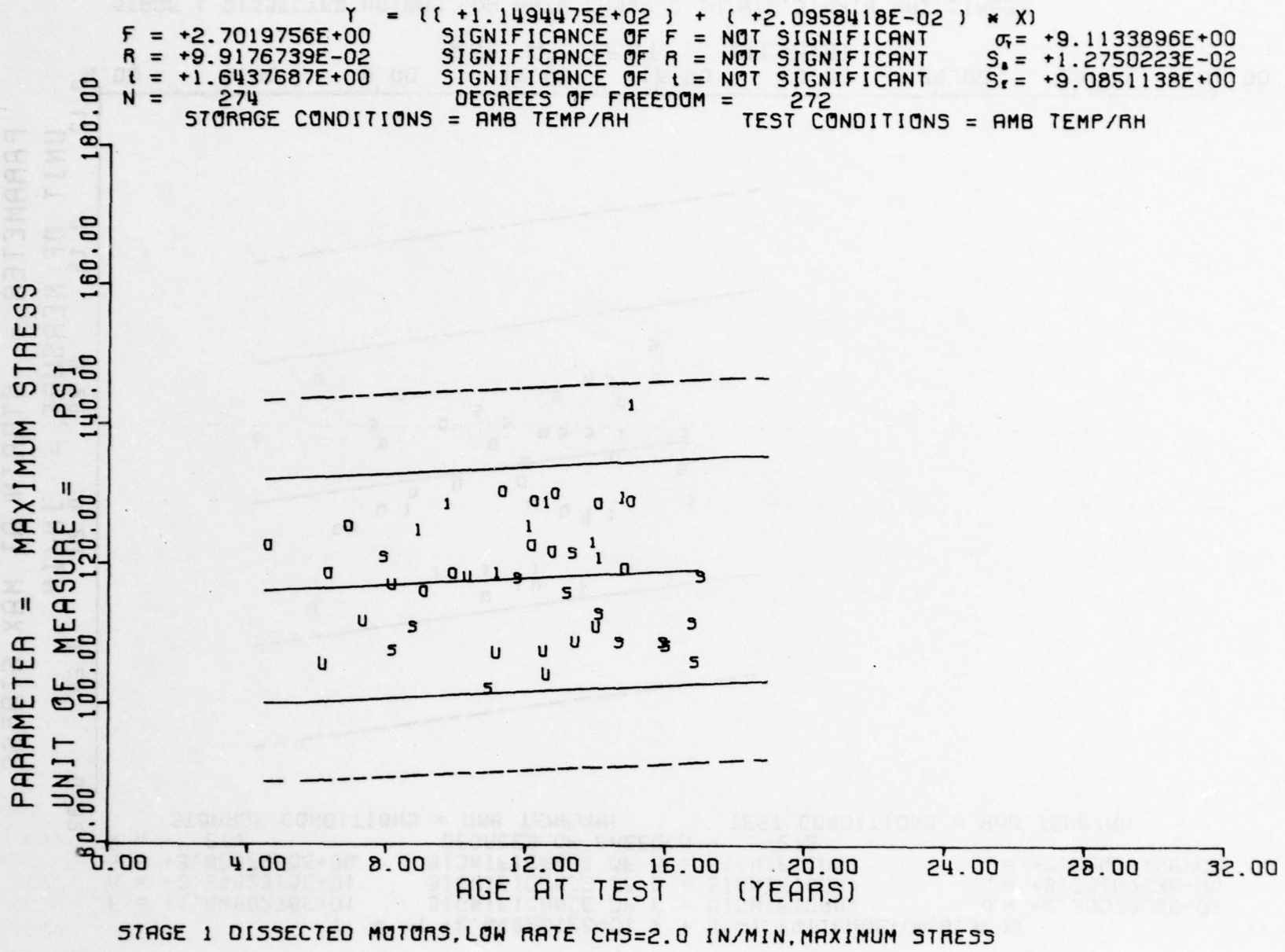
R = -2.2482318E-01 SIGNIFICANCE OF R = SIGNIFICANT
t = +3.8052960E+00 SIGNIFICANCE OF t = SIGNIFICANT
N = 274 DEGREES OF FREEDOM = 272
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT MAX STRESS
UNIT OF MEASURE = IN/IN
0.12
0.16
0.20
0.24
0.28
0.32
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTORS,LOW RATE CHS=2.0 IN/MIN,STRAIN MAX STRESS

Figure 1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R = +9.9176739E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT S_a = +1.2750223E-02
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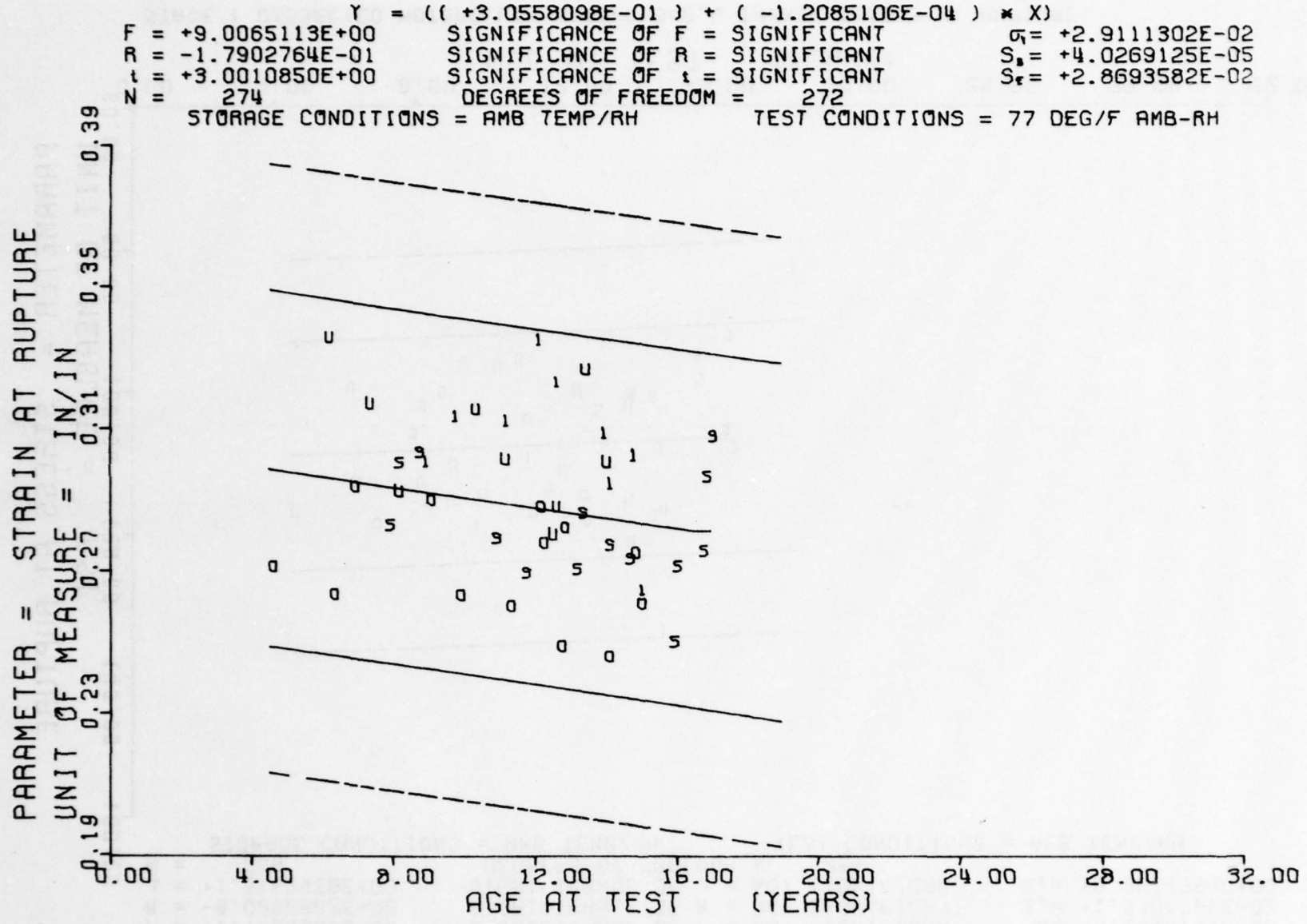
PARAMETER = MAXIMUM STRESS
UNIT OF MEASURE = PSI
80.00
100.00
120.00
140.00
160.00
180.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTORS, LOW RATE CHS=2.0 IN/MIN, MAXIMUM STRESS

Figure 2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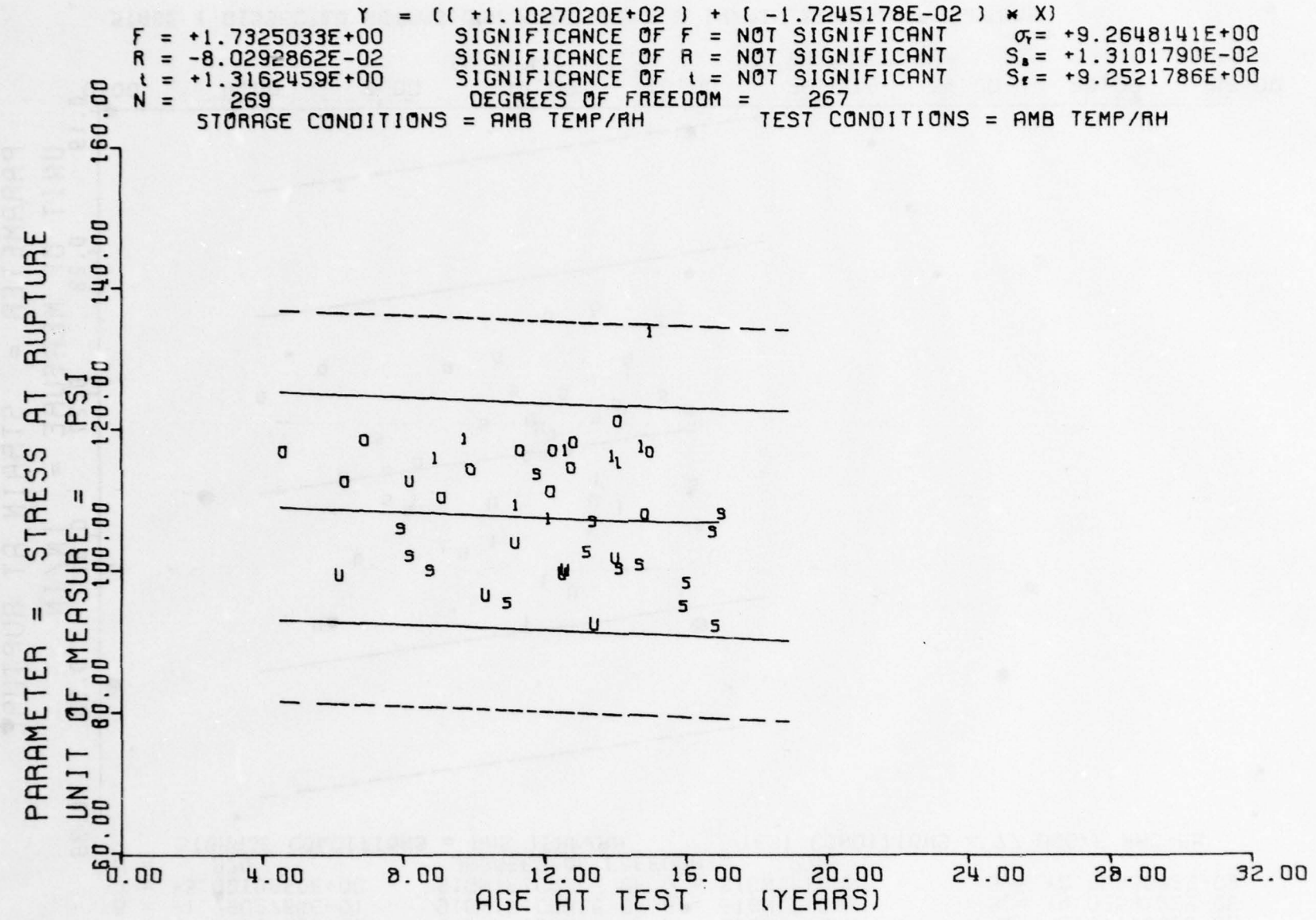
R = -1.7902764E-01 SIGNIFICANCE OF R = SIGNIFICANT Sb = +4.0269125E-05
t = +3.0010850E+00 SIGNIFICANCE OF t = SIGNIFICANT Se = +2.8693582E-02
N = 274 DEGREES OF FREEDOM = 272
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 77 DEG/F AMB-RH
PARAMETER = STRAIN AT RUPTURE
UNIT OF MEASURE = IN/IN
0.39
0.35
0.31
0.27
0.23
0.19
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTORS,LOW RATE CHS=2.0 IN/MIN,STRAIN AT RUPTURE

Figure 3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R = -8.0292862E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT Sa= +1.3101790E-02
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N = 269 DEGREES OF FREEDOM = 267
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PARAMETER = STRESS AT RUPTURE
UNIT OF MEASURE = PSI
160.00
140.00
120.00
100.00
80.00
60.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTORS,LOW RATE CHS=2.0 IN/MIN,STRESS AT RUPTURE

Figure 4

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES	AGE (MONTHS)	NR SAMPLES
54.0	26	168.0	16
73.0	24	175.0	8
82.0	5	176.0	3
87.0	5	177.0	5
94.0	16	179.0	8
97.0	5	190.0	3
104.0	5	191.0	5
106.0	5	200.0	3
108.0	5	201.0	3
123.0	4	203.0	5
130.0	5		
133.0	5		
135.0	3		
144.0	5		
145.0	3		
146.0	2		
149.0	3		
150.0	10		
152.0	3		
153.0	5		
157.0	3		
159.0	24		
160.0	5		
166.0	5		
167.0	5		

STAGE 1 DISSECTED MOTORS,LOW RATE CHS=2.0 IN/MIN,MODULUS

This sample size summary is applicable to figure 5.

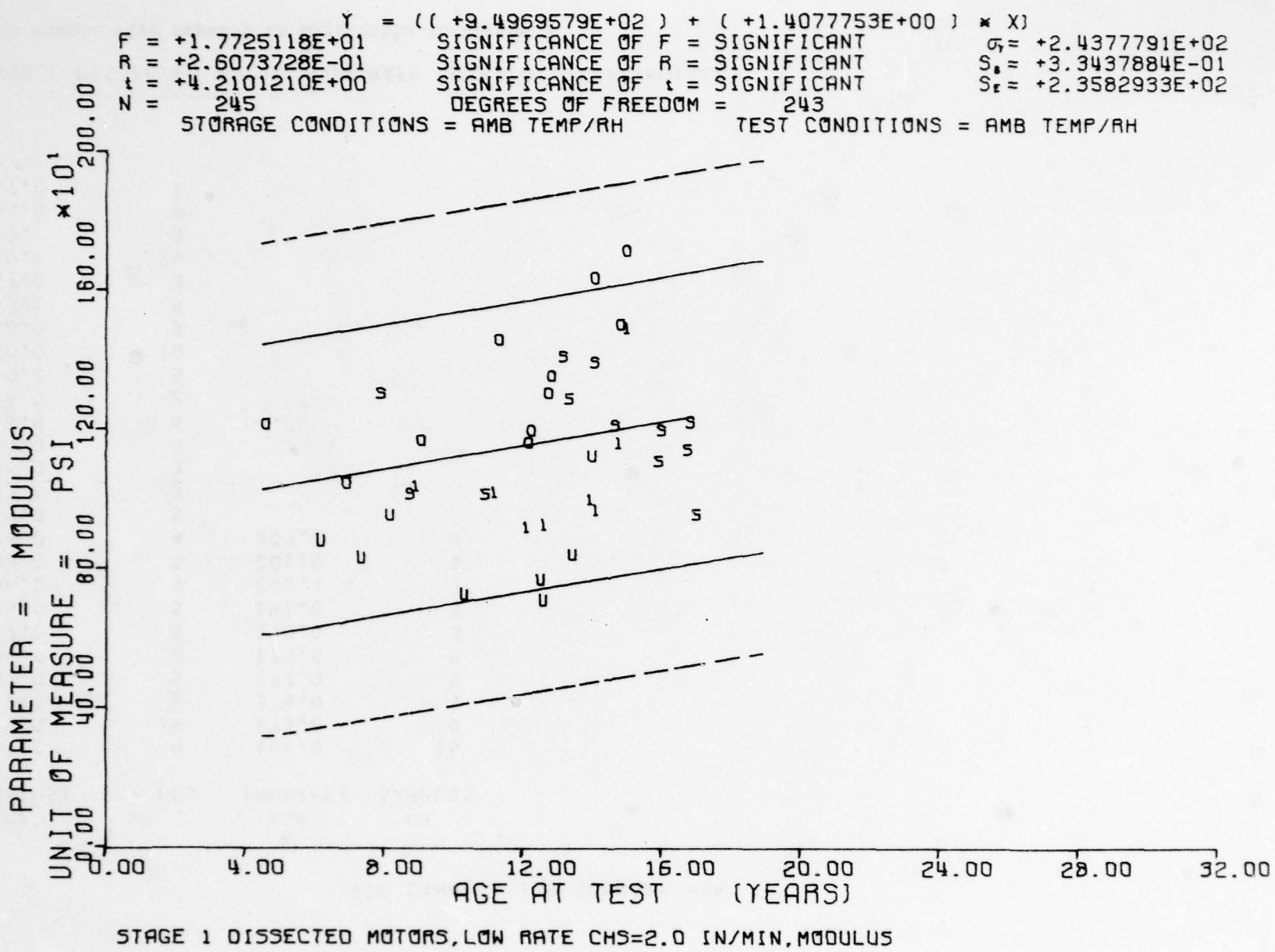

Y = ((+9.4969579E+02) + (+1.4077753E+00) * X)
F = +1.7725118E+01 SIGNIFICANCE OF F = SIGNIFICANT
R = +2.6073728E-01 SIGNIFICANCE OF R = SIGNIFICANT
t = +4.2101210E+00 SIGNIFICANCE OF t = SIGNIFICANT
N = 245 DEGREES OF FREEDOM = 243
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
σy = +2.4377791E+02
Sa = +3.3437884E-01
Sε = +2.3582933E+02
PARAMETER = MODULUS
UNIT OF MEASURE = PSI x10¹
0.00
40.00
80.00
120.00
160.00
200.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTORS, LOW RATE CHS=2.0 IN/MIN, MODULUS

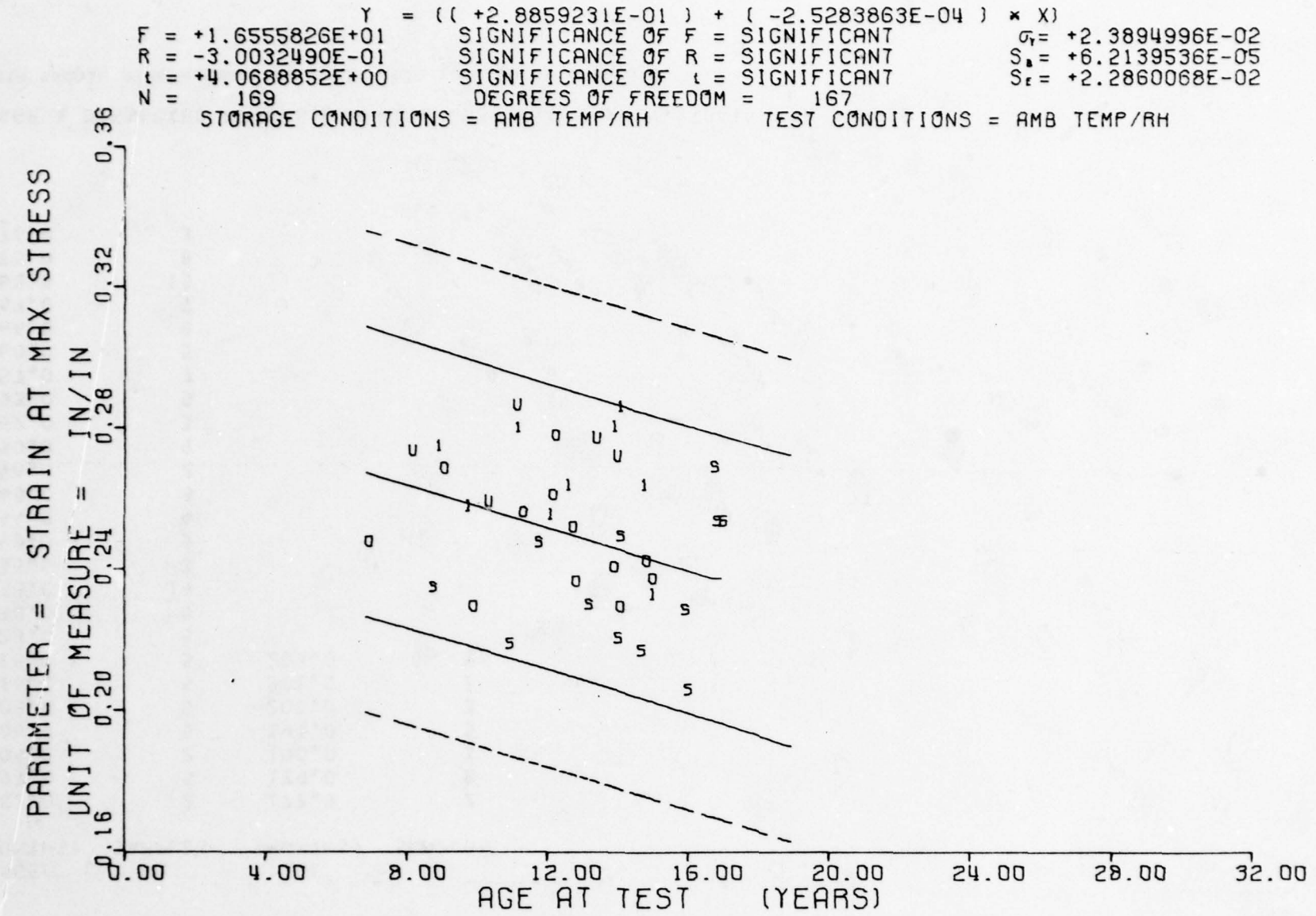
Figure 5

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES	AGE (MONTHS)	NR SAMPLES
82.0	2	177.0	2
97.0	5	179.0	8
104.0	2	190.0	3
106.0	5	191.0	5
108.0	5	200.0	3
116.0	5	201.0	3
118.0	5	203.0	5
123.0	5		
130.0	5		
133.0	14		
135.0	3		
140.0	5		
144.0	4		
145.0	3		
146.0	2		
150.0	9		
152.0	3		
153.0	5		
157.0	7		
160.0	5		
166.0	8		
167.0	7		
168.0	15		
175.0	8		
176.0	3		

STAGE 1 DISSECTED MOTORS,LOW RATE CHS=20.0 IN/MIN,STRAIN MAX STRESS

This sample size summary is applicable to figures 6 thru 9.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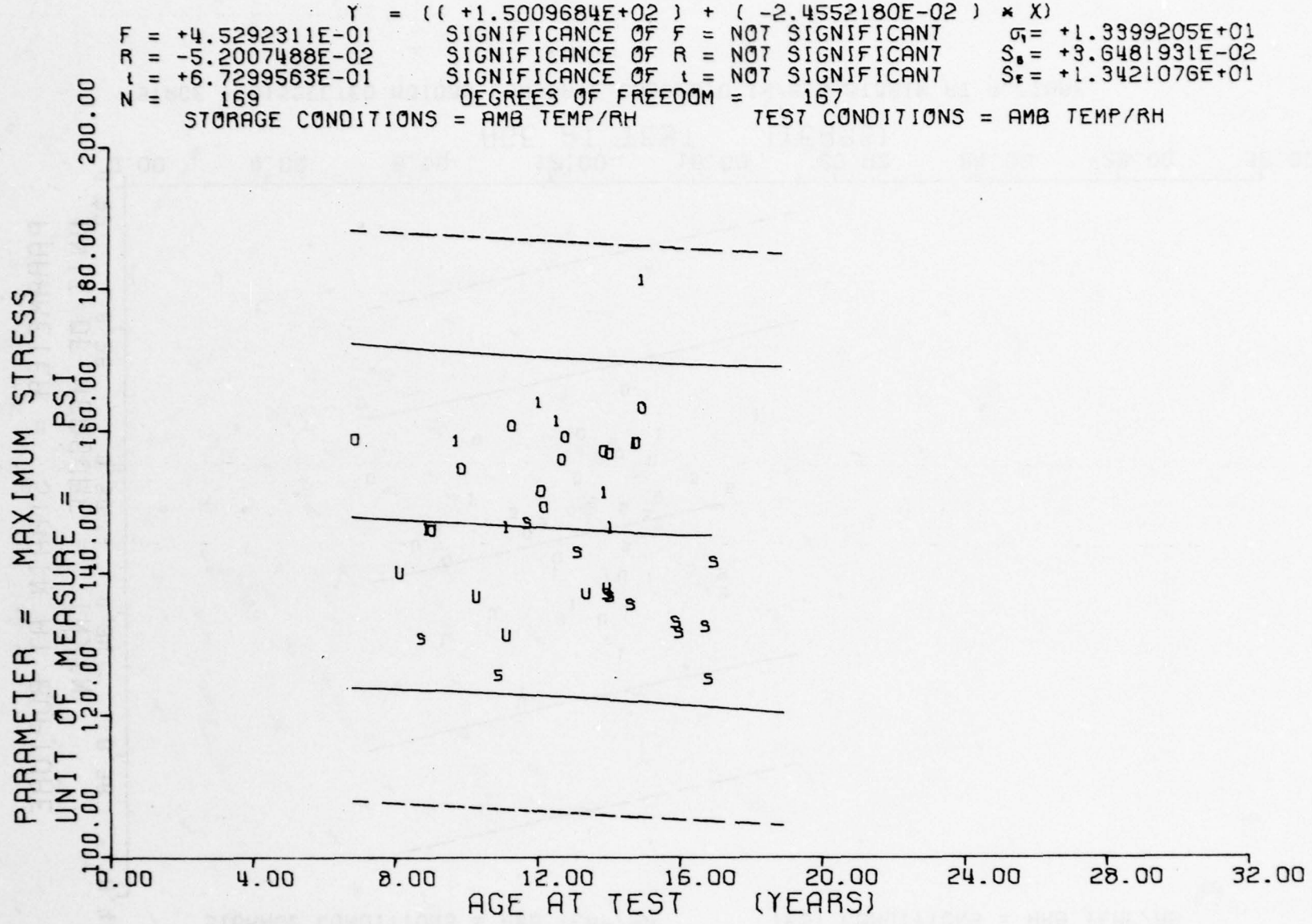
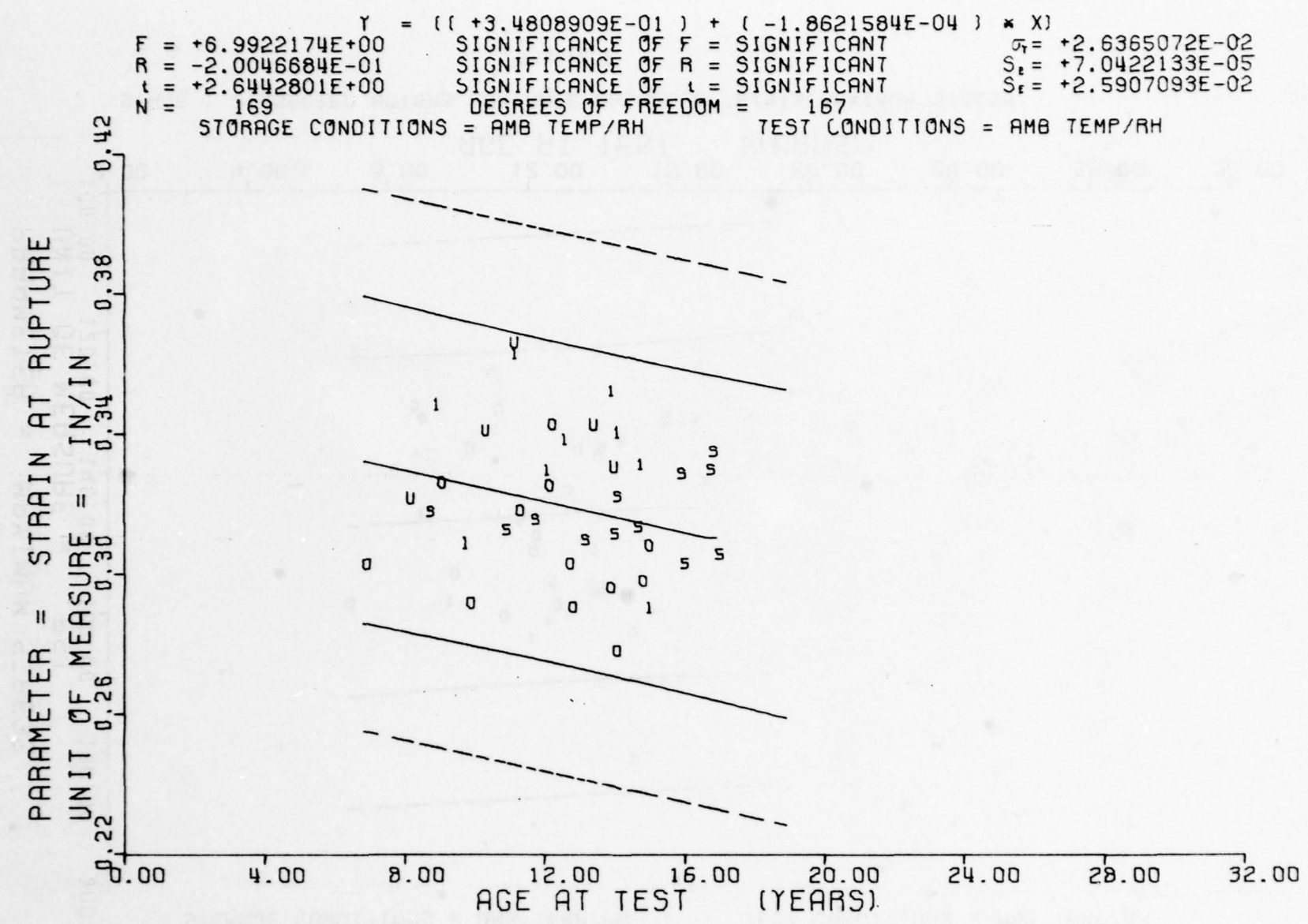
R = -3.0032490E-01 SIGNIFICANCE OF R = SIGNIFICANT
t = +4.0688852E+00 SIGNIFICANCE OF t = SIGNIFICANT
N = 169 DEGREES OF FREEDOM = 167
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT MAX STRESS
UNIT OF MEASURE = IN/IN
0.36
0.32
0.28
0.24
0.20
0.16
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTORS,LOW RATE CHS=20.0 IN/MIN,STRAIN MAX STRESS

Figure 6



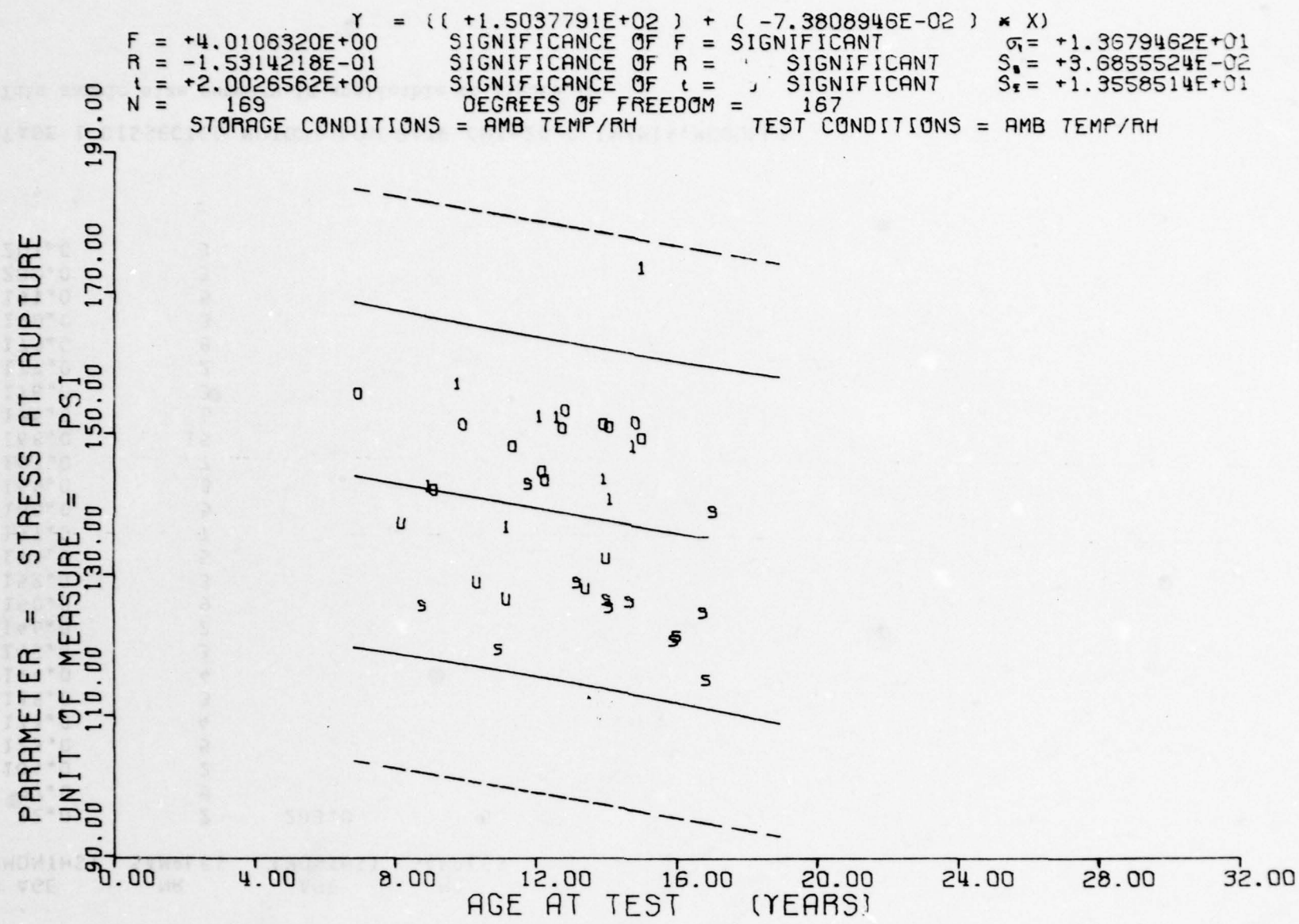
STAGE 1 DISSECTED MOTORS,LOW RATE CHS=20.0 IN/MIN,MAXIMUM STRESS

Figure 7



STAGE 1 DISSECTED MOTORS, LOW RATE CHS=20.0 IN/MIN, STRAIN AT RUPTURE

Figure 8



STAGE 1 DISSECTED MOTORS,LOW RATE CHS=20.0 IN/MIN,STRESS AT RUPTURE

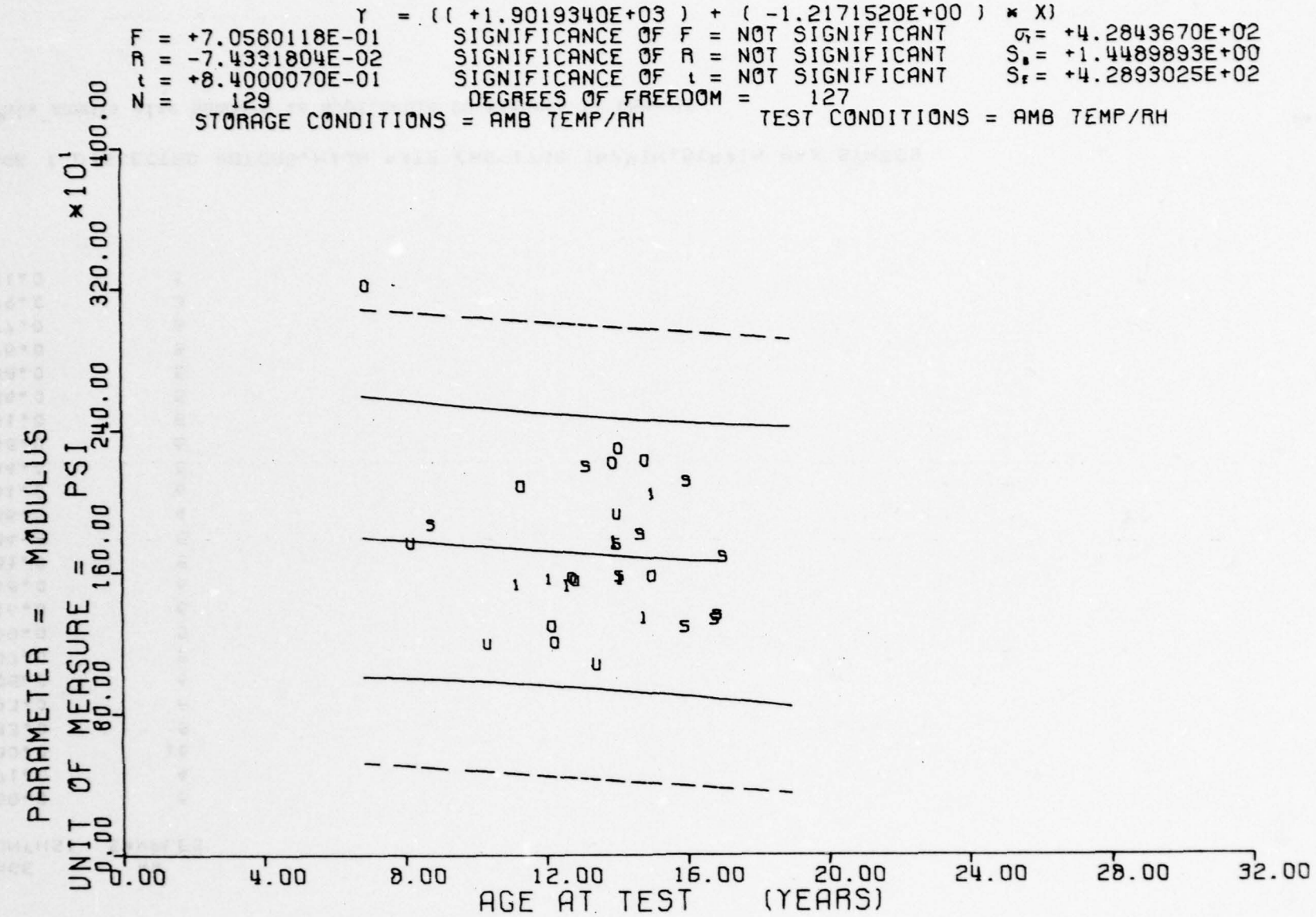
Figure 9

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES	AGE (MONTHS)	NR SAMPLES
82.0	2	203.0	5
97.0	5		
104.0	2		
123.0	5		
133.0	4		
135.0	3		
144.0	4		
145.0	3		
146.0	2		
150.0	9		
152.0	3		
153.0	5		
157.0	7		
160.0	5		
166.0	8		
167.0	7		
168.0	15		
175.0	8		
176.0	3		
177.0	2		
179.0	8		
190.0	3		
191.0	5		
200.0	3		
201.0	3		

STAGE 1 DISSECTED MOTORS,LOW RATE CHS=20.0 IN/MIN,MCDULLS

This sample size summary is applicable to figure 10.



STAGE 1 DISSECTED MOTORS,LOW RATE CHS=20.0 IN/MIN,MODULUS

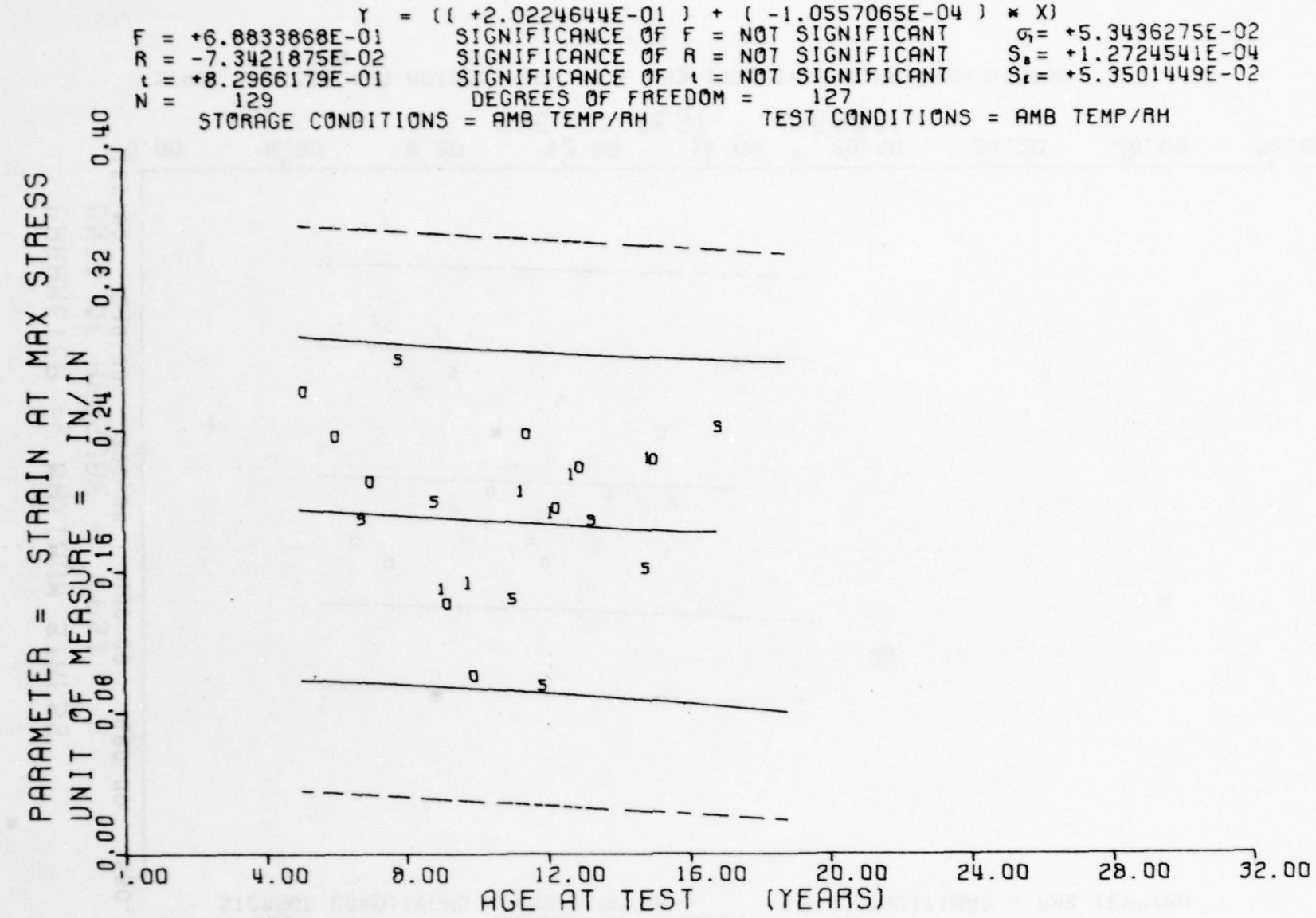
Figure 10

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES
60.0	6
71.0	4
80.0	16
83.0	5
93.0	6
105.0	6
107.0	5
109.0	5
116.0	6
118.0	6
131.0	5
134.0	5
136.0	4
141.0	6
144.0	5
146.0	5
151.0	5
154.0	5
158.0	5
176.0	5
177.0	6
179.0	3
201.0	5

STAGE 1 DISSECTED MOTORS, HIGH RATE CHS=1750 IN/MIN, STRAIN MAX STRESS

This sample size summary is applicable to figures 11 thru 15.



STAGE 1 DISSECTED MOTORS, HIGH RATE CHS=1750 IN/MIN, STRAIN MAX STRESS

Figure 11

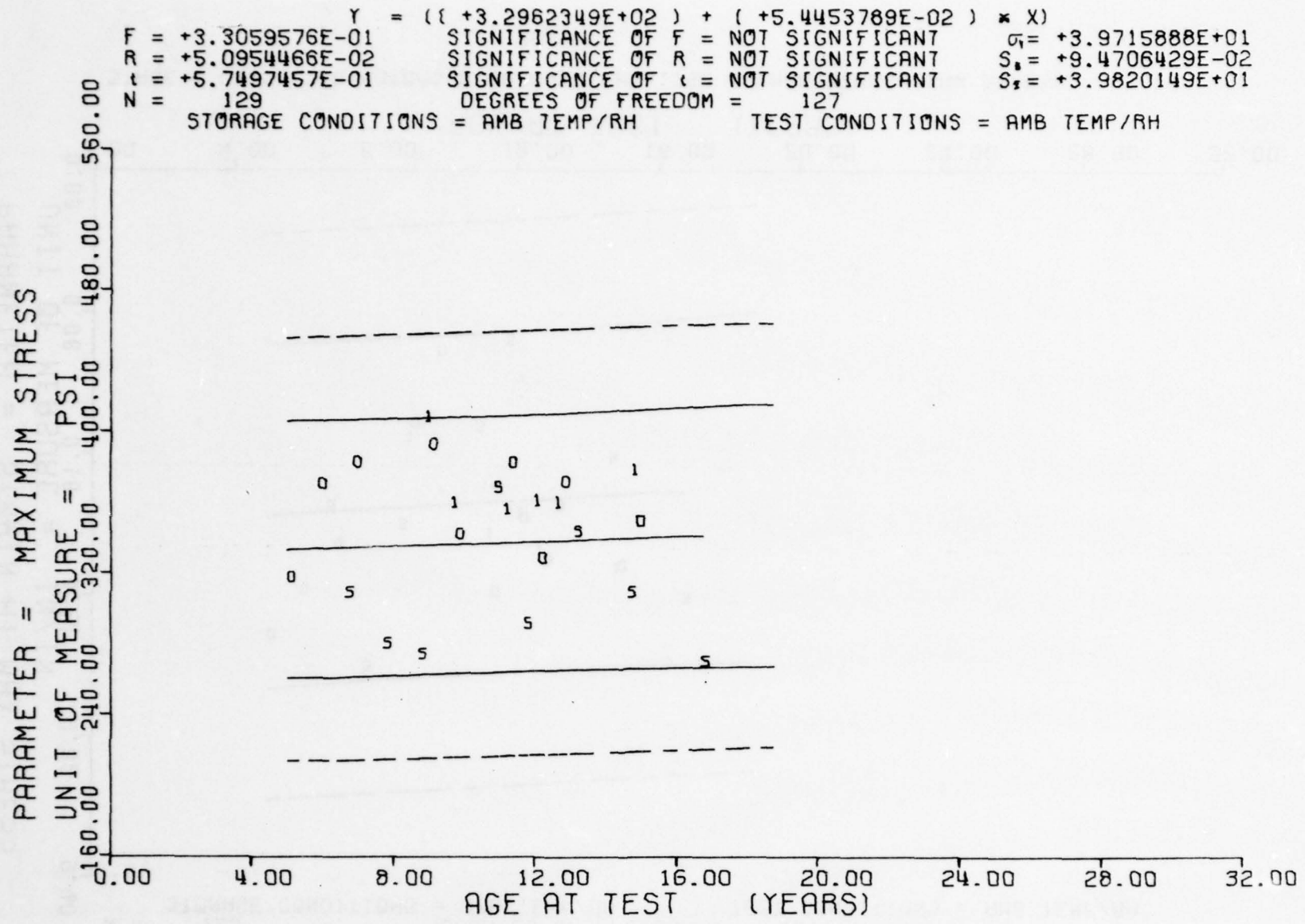
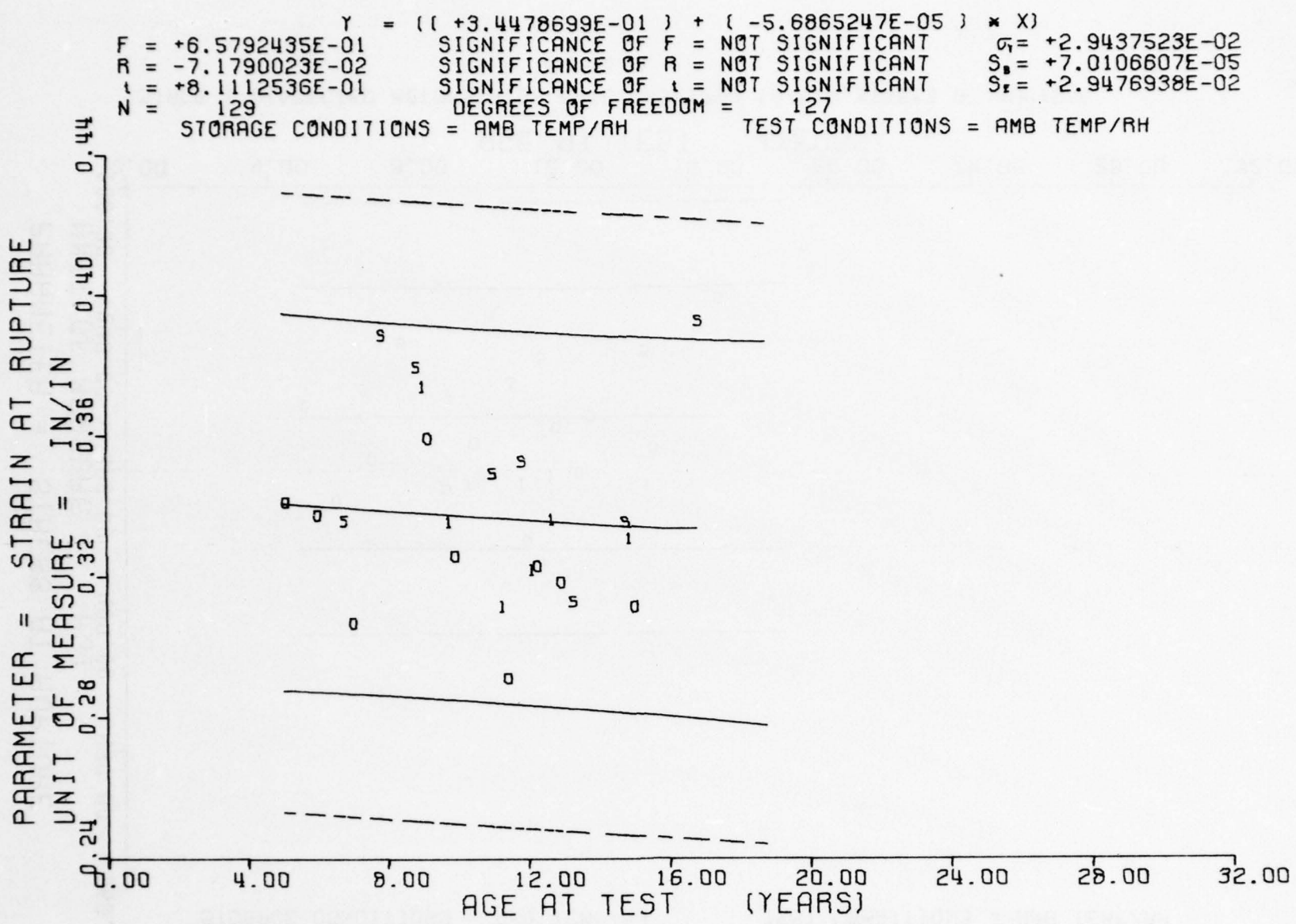
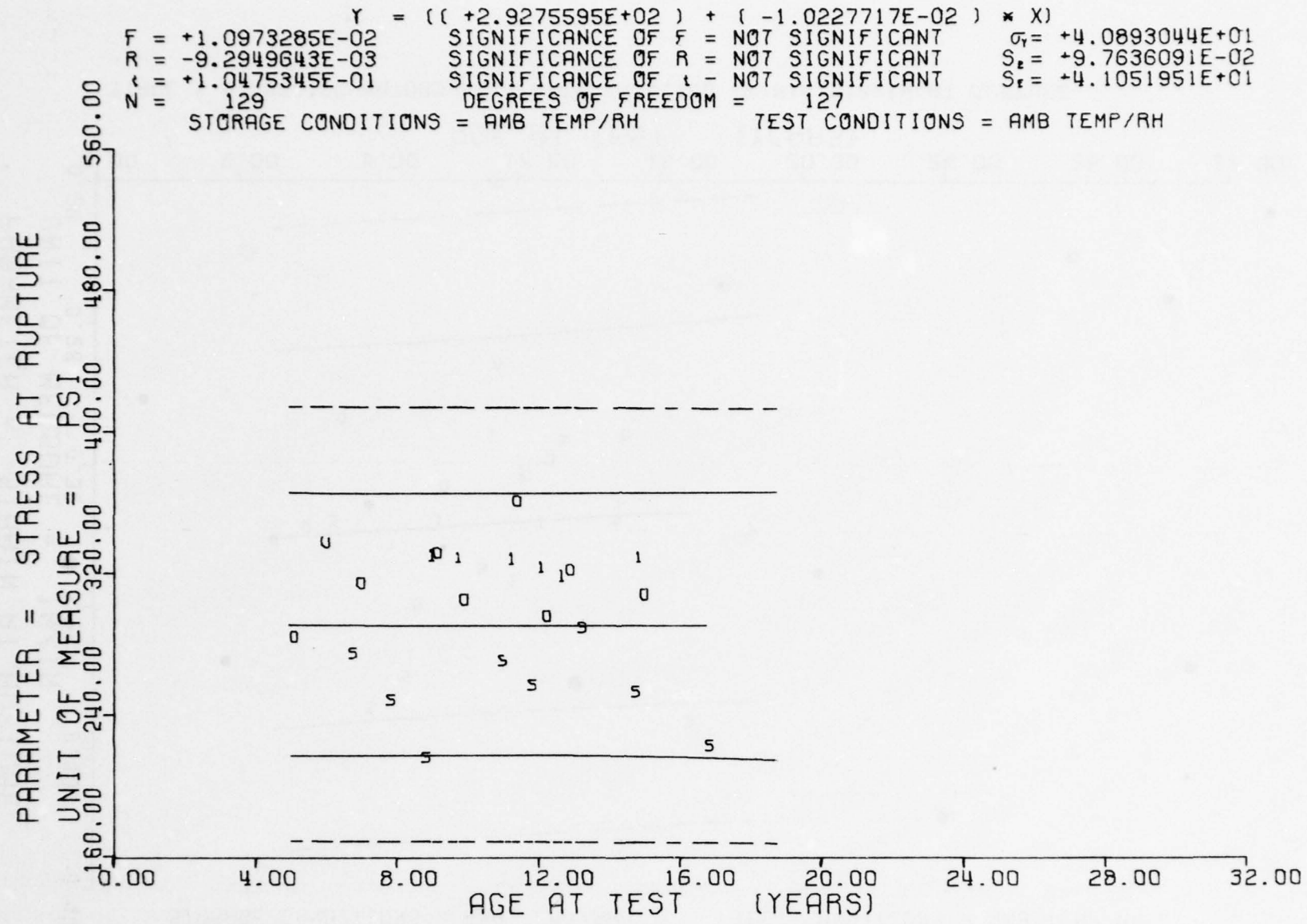

Y = ((+3.2962349E+02) + (+5.4453789E-02) * X)
F = +3.3059576E-01 SIGNIFICANCE OF F = NOT SIGNIFICANT σ1 = +3.9715888E+01
R = +5.0954466E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT S0 = +9.4706429E-02
t = +5.7497457E-01 SIGNIFICANCE OF t = NOT SIGNIFICANT Sx = +3.9820149E+01
N = 129 DEGREES OF FREEDOM = 127
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = MAXIMUM STRESS
UNIT OF MEASURE = PSI
560.00
480.00
400.00
320.00
240.00
160.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTORS, HIGH RATE CHS=1750 IN/MIN, MAXIMUM STRESS

Figure 12



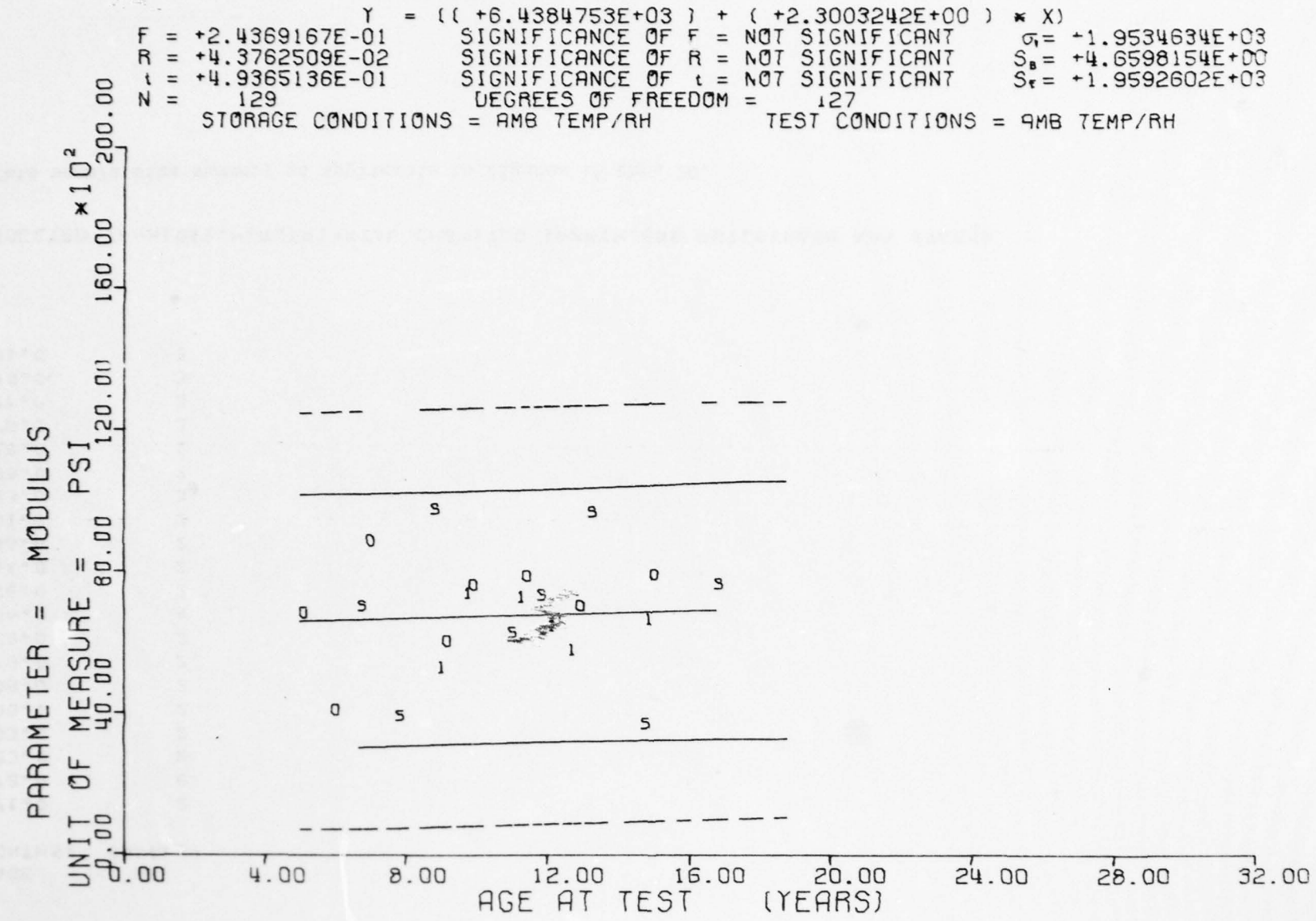
STAGE 1 DISSECTED MOTORS, HIGH RATE CHS=1750 IN/MIN, STRAIN AT RUPTURE

Figure 13



STAGE 1 DISSECTED MOTORS, HIGH RATE CHS=1750 IN/MIN, STRESS AT RUPTURE

Figure 14



STAGE 1 DISSECTED MOTORS, HIGH RATE CHS=1750 IN/MIN, MODULUS

Figure 15

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES
71.0	2
72.0	8
83.0	2
93.0	2
105.0	2
108.0	2
110.0	2
132.0	2
134.0	4
136.0	2
144.0	2
146.0	2
151.0	3
153.0	3
158.0	2
168.0	2
175.0	3
177.0	3
179.0	3
201.0	3

DISSECTED TP-H1011,H.R.TRIAXIAL CHS=1750 IN/MIN,600 PSI,STRAIN MAX STRESS

This sample size summary is applicable to figures 16 thru 20.

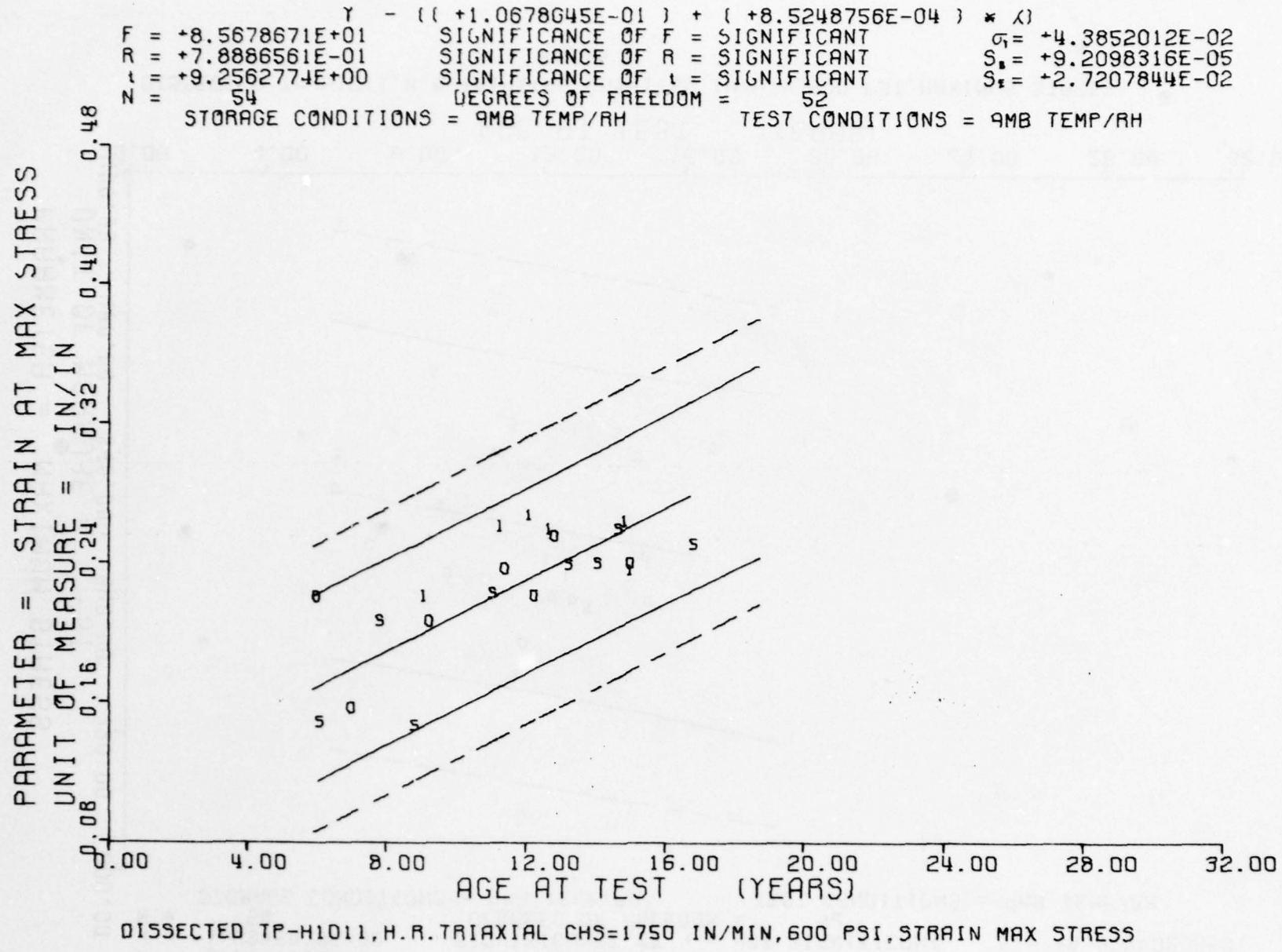

Y - ((+1.0678645E-01) + (+8.5248756E-04) * X)
F = +8.5678671E+01 SIGNIFICANCE OF F = SIGNIFICANT σ1 = +4.3852012E-02
R = +7.8886561E-01 SIGNIFICANCE OF R = SIGNIFICANT S1 = +9.2098316E-05
t = +9.2562774E+00 SIGNIFICANCE OF t = SIGNIFICANT S2 = +2.7207844E-02
N = 54 DEGREES OF FREEDOM = 52
STORAGE CONDITIONS = 9MB TEMP/RH TEST CONDITIONS = 9MB TEMP/RH
PARAMETER = STRAIN AT MAX STRESS
UNIT OF MEASURE = IN/IN
0.08
0.16
0.24
0.32
0.40
0.48
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
DISSECTED TP-H1011,H.R.TRIAXIAL CHS=1750 IN/MIN,600 PSI,STRAIN MAX STRESS

Figure 16

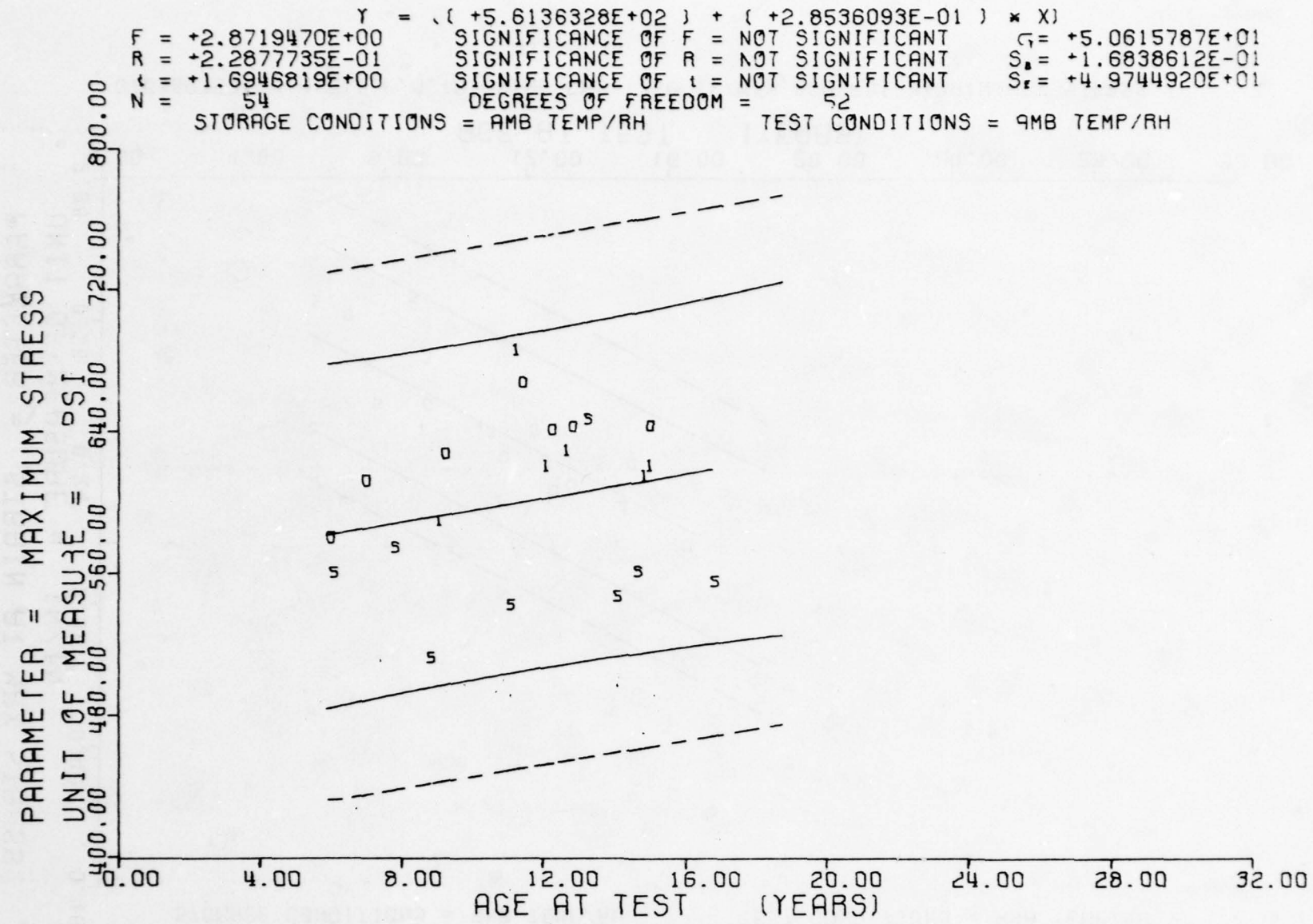

Y = (+5.6136328E+02) + (+2.8536093E-01) * X)
F = +2.8719470E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT σ = +5.0615787E+01
R = +2.2877735E-01 SIGNIFICANCE OF R = NOT SIGNIFICANT Sa = +1.6838612E-01
t = +1.6946819E+00 SIGNIFICANCE OF t = NOT SIGNIFICANT Sr = +4.9744920E+01
N = 54 DEGREES OF FREEDOM = 52
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = MAXIMUM STRESS
UNIT OF MEASURE = PSI
800.00
720.00
640.00
560.00
480.00
400.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
DISSECTED TP-H1011,H.R.TRIAXIAL CHS=1750 IN/MIN,600 PSI,MAXIMUM STRESS

Figure 17

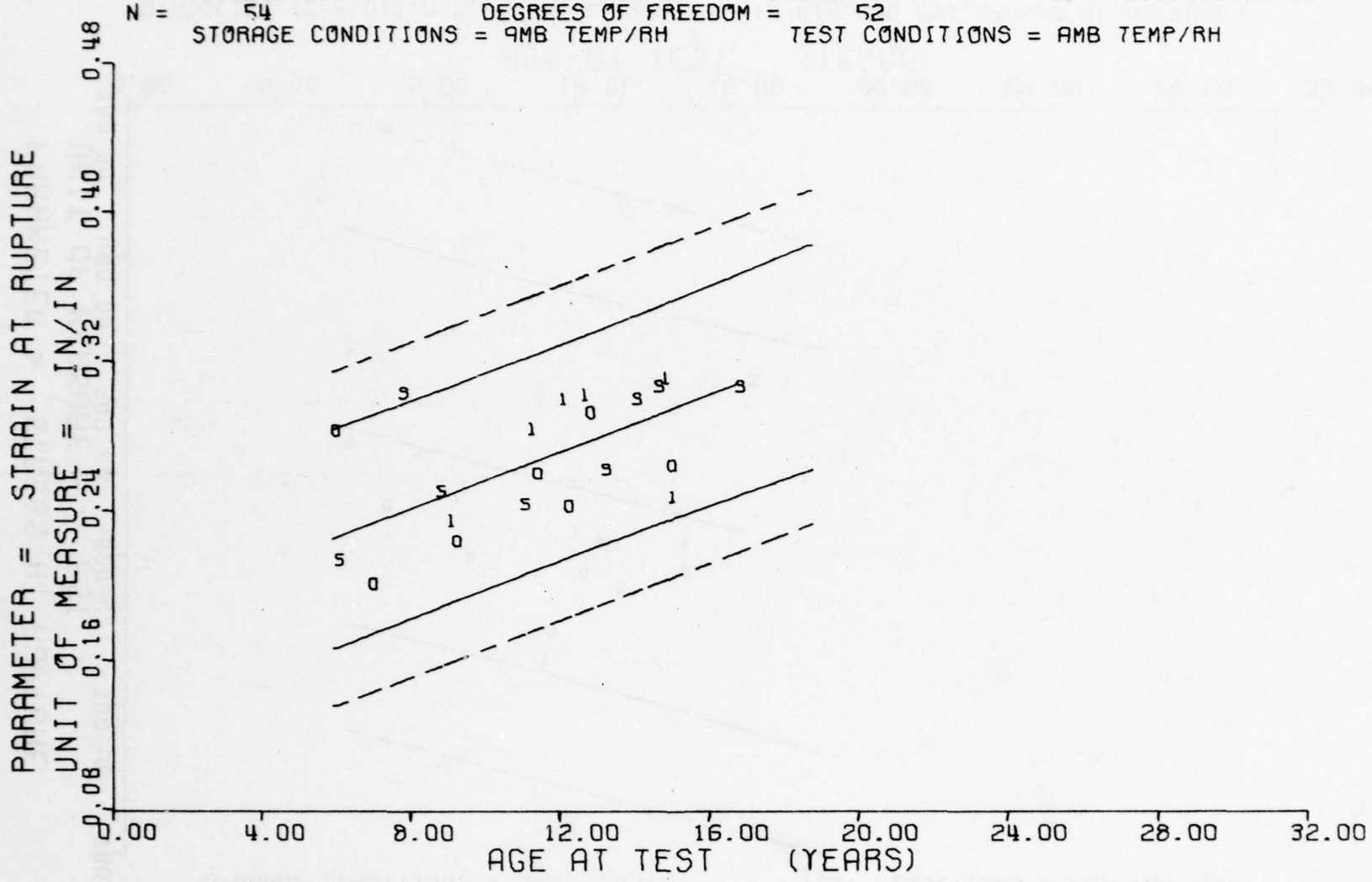
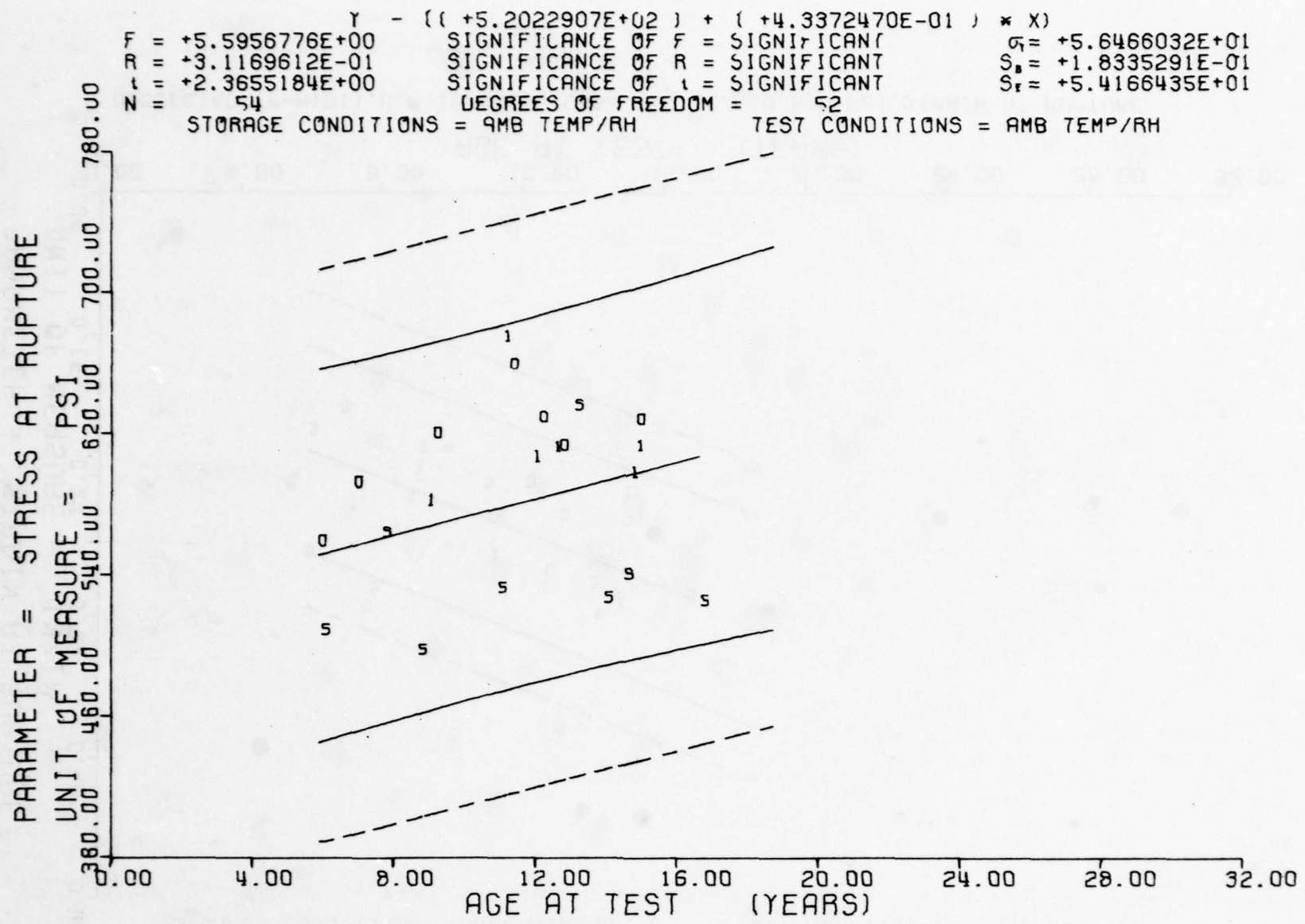
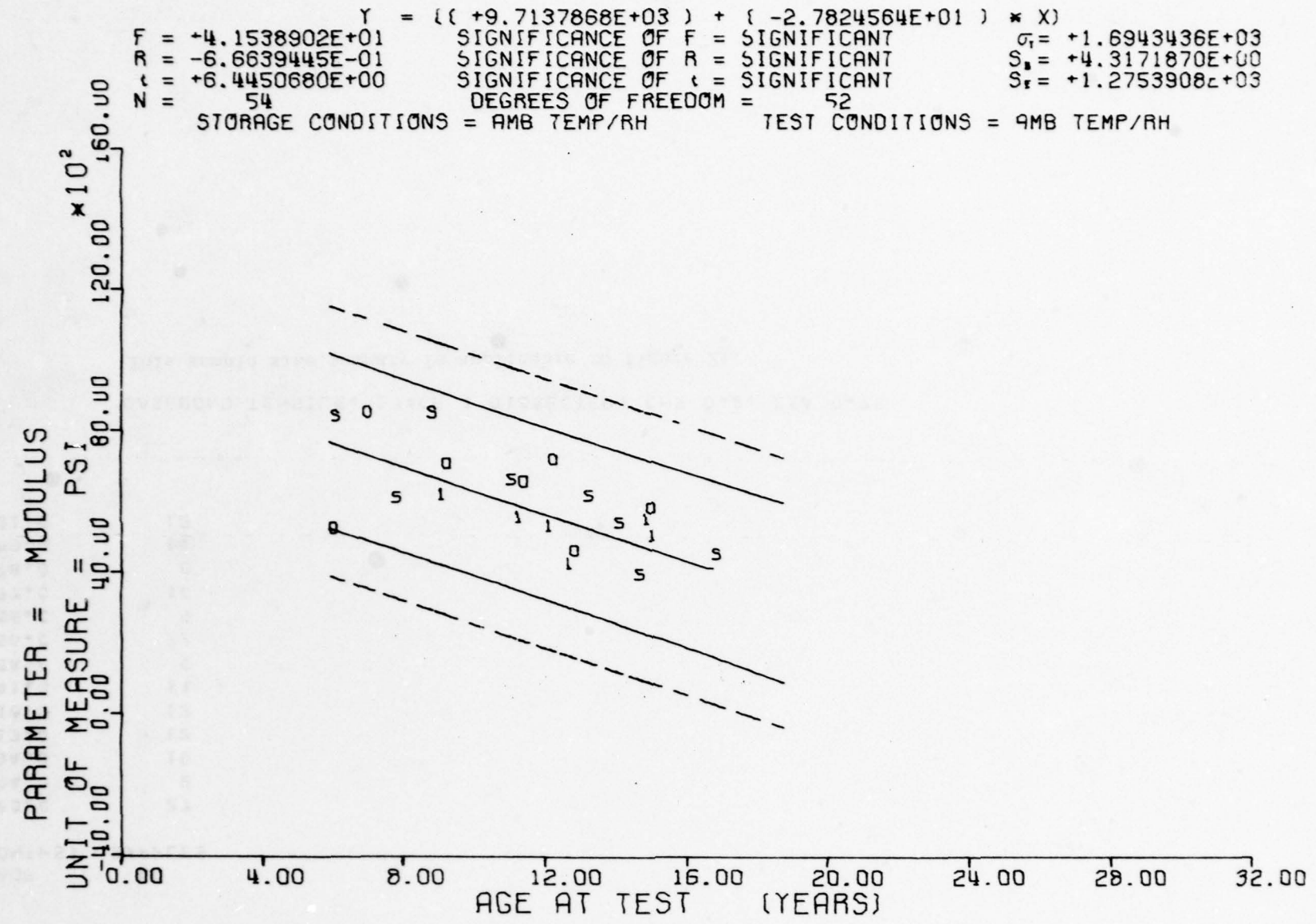

Y = ((+1.7998126E-01) + (+6.3570593E-04) * X)
F = +3.9996396E+01 SIGNIFICANCE OF F = SIGNIFICANT σ1 = +3.9123324E-02
R = +6.5936368E-01 SIGNIFICANCE OF R = SIGNIFICANT Se = +1.0051846E-04
t = +6.3242704E+00 SIGNIFICANCE OF t = SIGNIFICANT St = +2.9695338E-02
N = 54 DEGREES OF FREEDOM = 52
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT RUPTURE
UNIT OF MEASURE = IN/IN
0.48
0.40
0.32
0.24
0.16
0.08
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
DISSECTED TP-H1011,H.R.TRIAXIAL CHS=1750 IN/MIN,600 PSI,STRAIN AT RUPTURE

Figure 18



DISSECTED TP-H1011,H.R.TRIAXIAL CHS=1750 IN/MIN,600 PSI,STRESS AT RUPTURE

Figure 19



DISSECTED TP-H1011,H.R.TRIAXIAL CHS=1750 IN/MIN,600 PSI,MODULUS

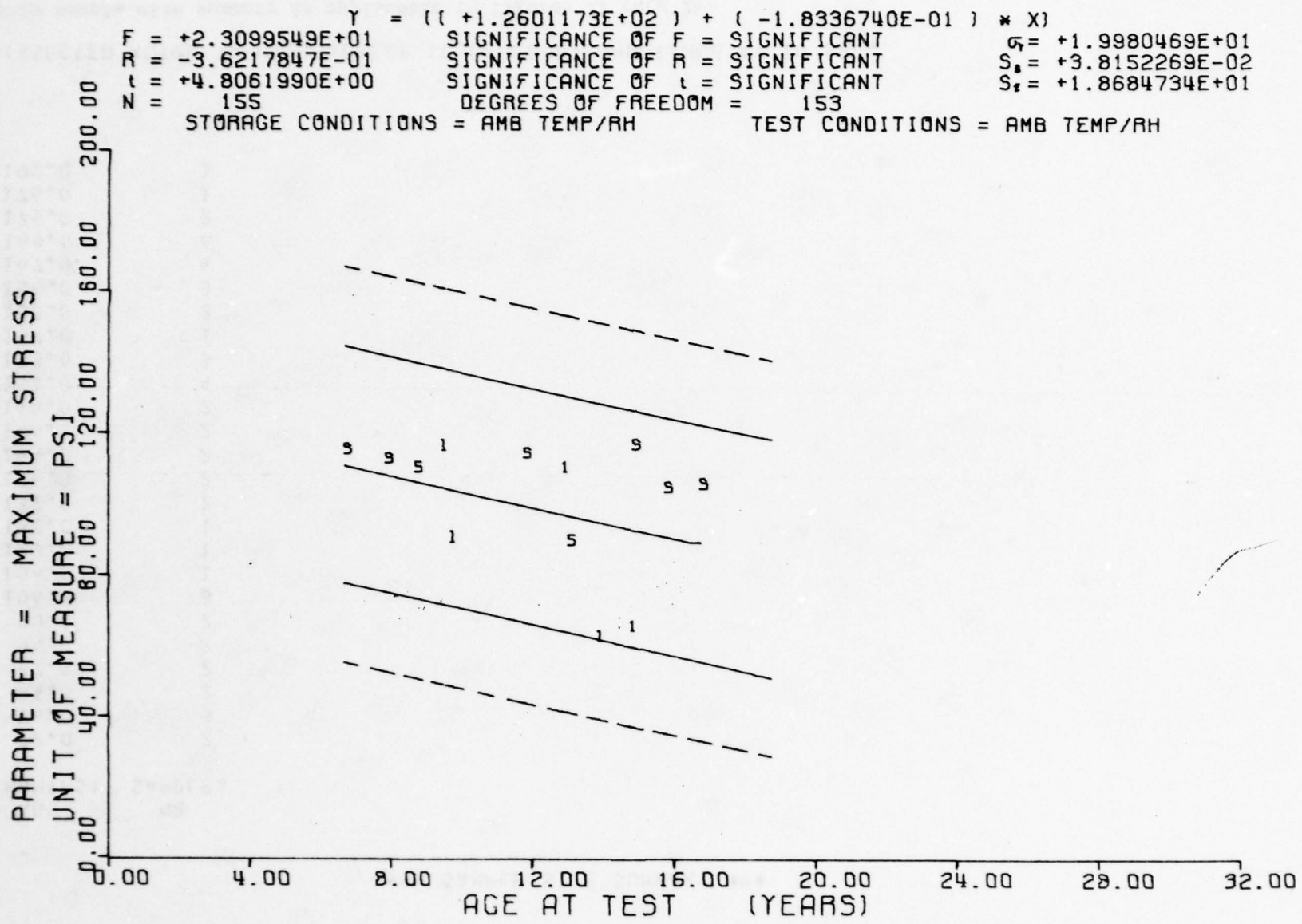
Figure 20

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES
80.0	27
94.0	2
104.0	10
113.0	12
116.0	12
141.0	11
154.0	9
156.0	22
166.0	9
177.0	10
178.0	8
189.0	11
201.0	12

CASEBOND TENSILE, STAGE 1 DISSECTED, CHS 0.2, CSA 0.75

This sample size summary is applicable to figure 21.



CASEBOND TENSILE, STAGE 1 DISSECTED, CHS 0.2, CSA 0.75

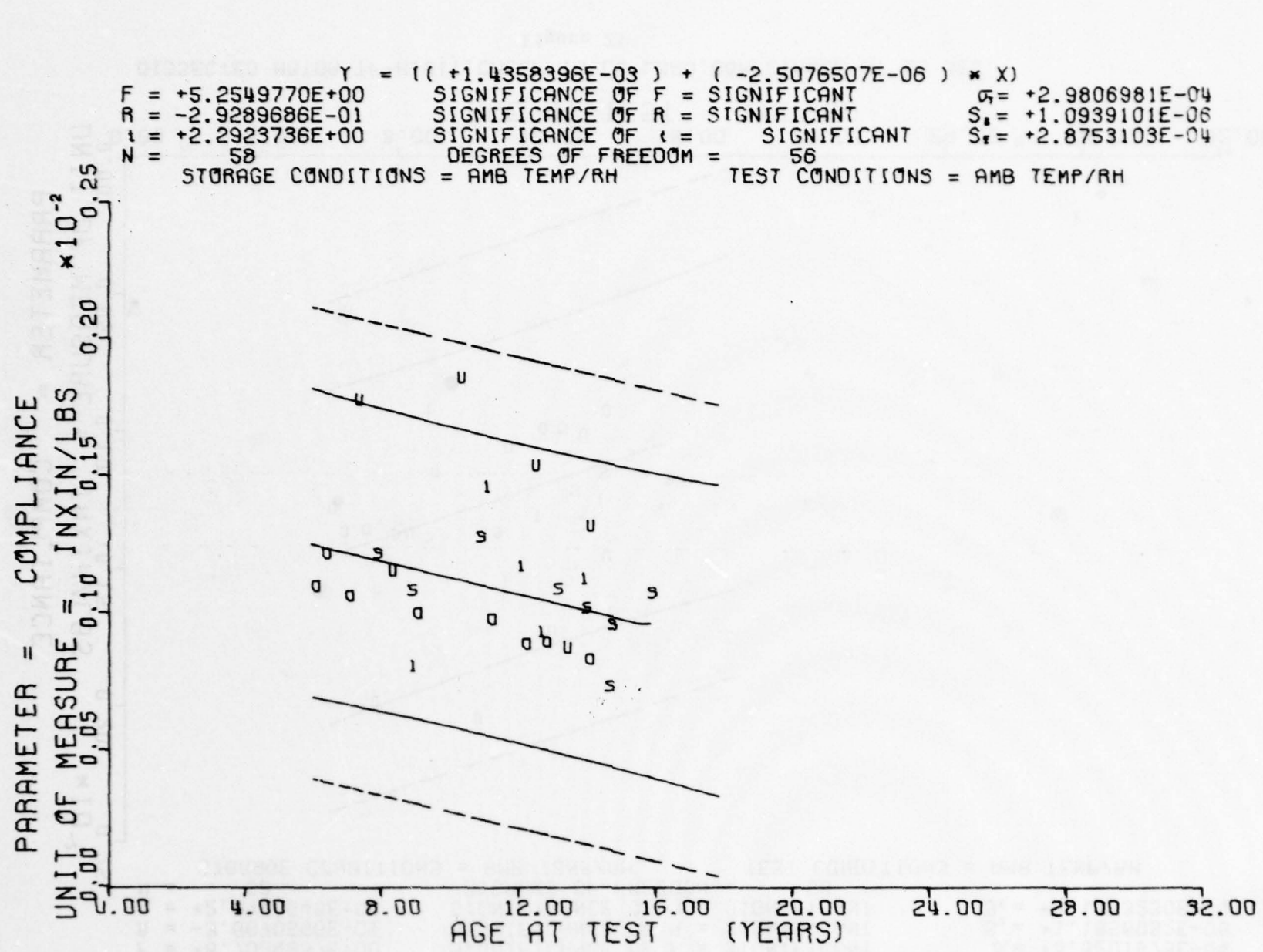
Figure 21

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES
72.0	2
76.0	3
84.0	2
87.0	2
94.0	2
99.0	2
106.0	3
108.0	1
123.0	1
130.0	1
132.0	2
134.0	2
144.0	2
146.0	2
149.0	2
151.0	4
153.0	3
157.0	1
160.0	2
166.0	3
167.0	4
168.0	6
175.0	2
176.0	1
190.0	3

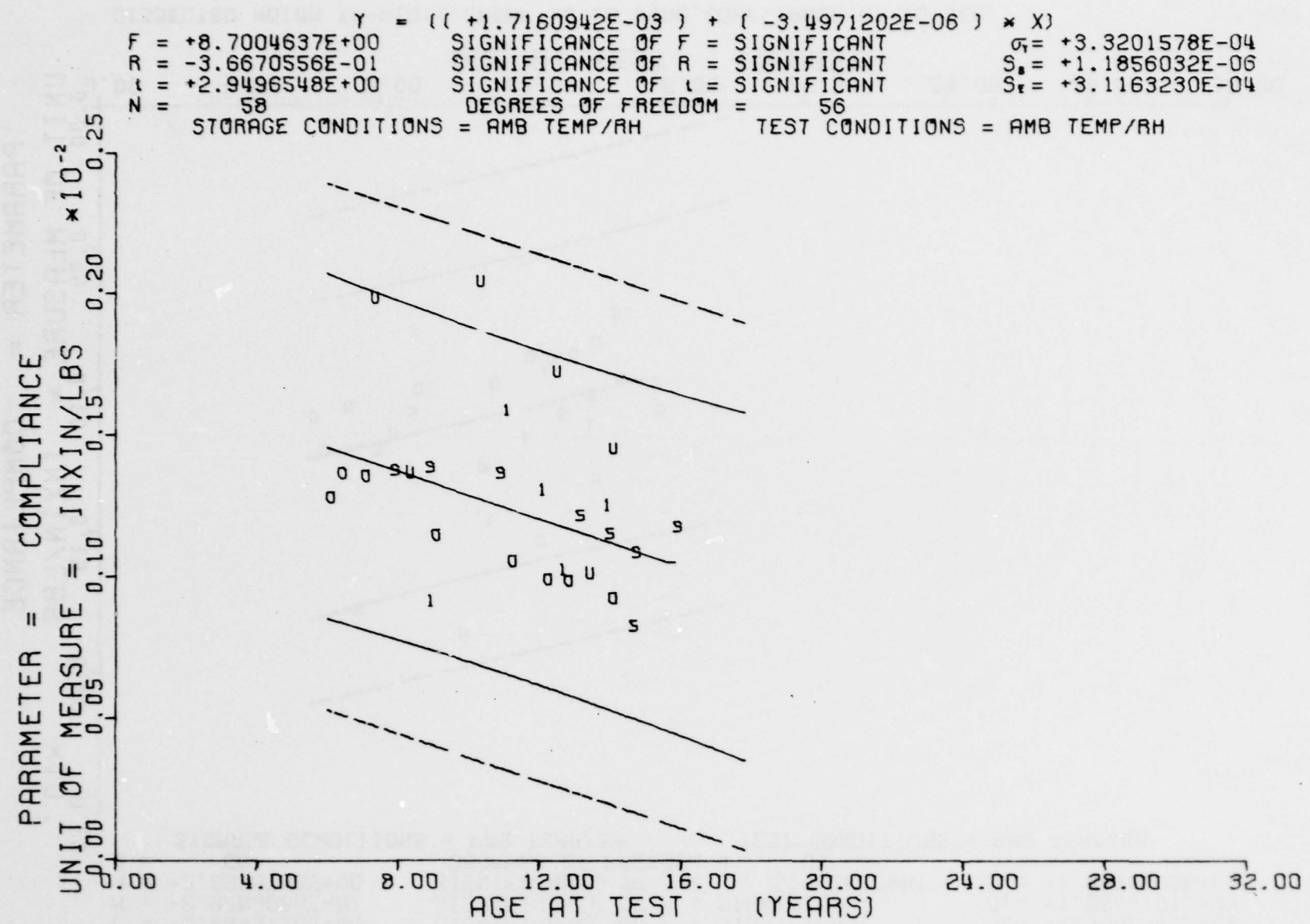
DISSECTED MOTOR TP-H1011,CREEP 10 LB LOAD,COMPLIANCE AT 10 SEC.

This sample size summary is applicable to figures 22 thru 24.



DISSECTED MOTOR TP-H1011, CREEP 10 LB LOAD, COMPLIANCE AT 10 SEC.

Figure 22



DISSECTED MOTOR TP-H1011, CREEP 10 LB LOAD, COMPLIANCE AT 20 SEC.

Figure 23

Y = ((+2.3591670E-03) + (-3.0793456E-06) * X)

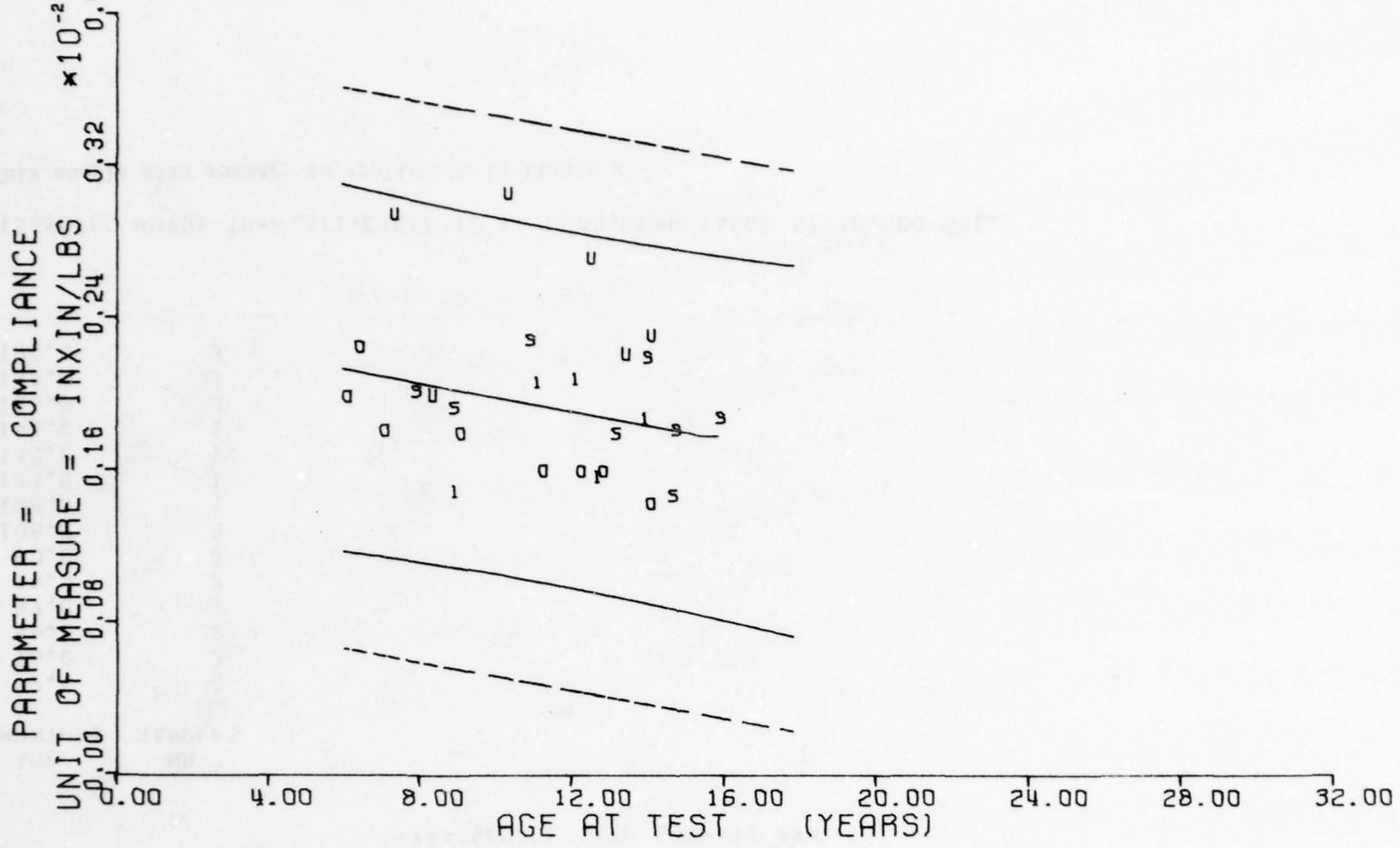
F = +2.7021144E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT σ_Y = +4.9968822E-04

R = -2.1454826E-01 SIGNIFICANCE OF R = NOT SIGNIFICANT S_b = +1.8732967E-06

t = +1.6438109E+00 SIGNIFICANCE OF t = NOT SIGNIFICANT S_r = +4.9239050E-04

N = 58 DEGREES OF FREEDOM = 56

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



DISSECTED MOTOR TP-H1011, CREEP 10 LB LOAD, COMPLIANCE AT 1000 SEC

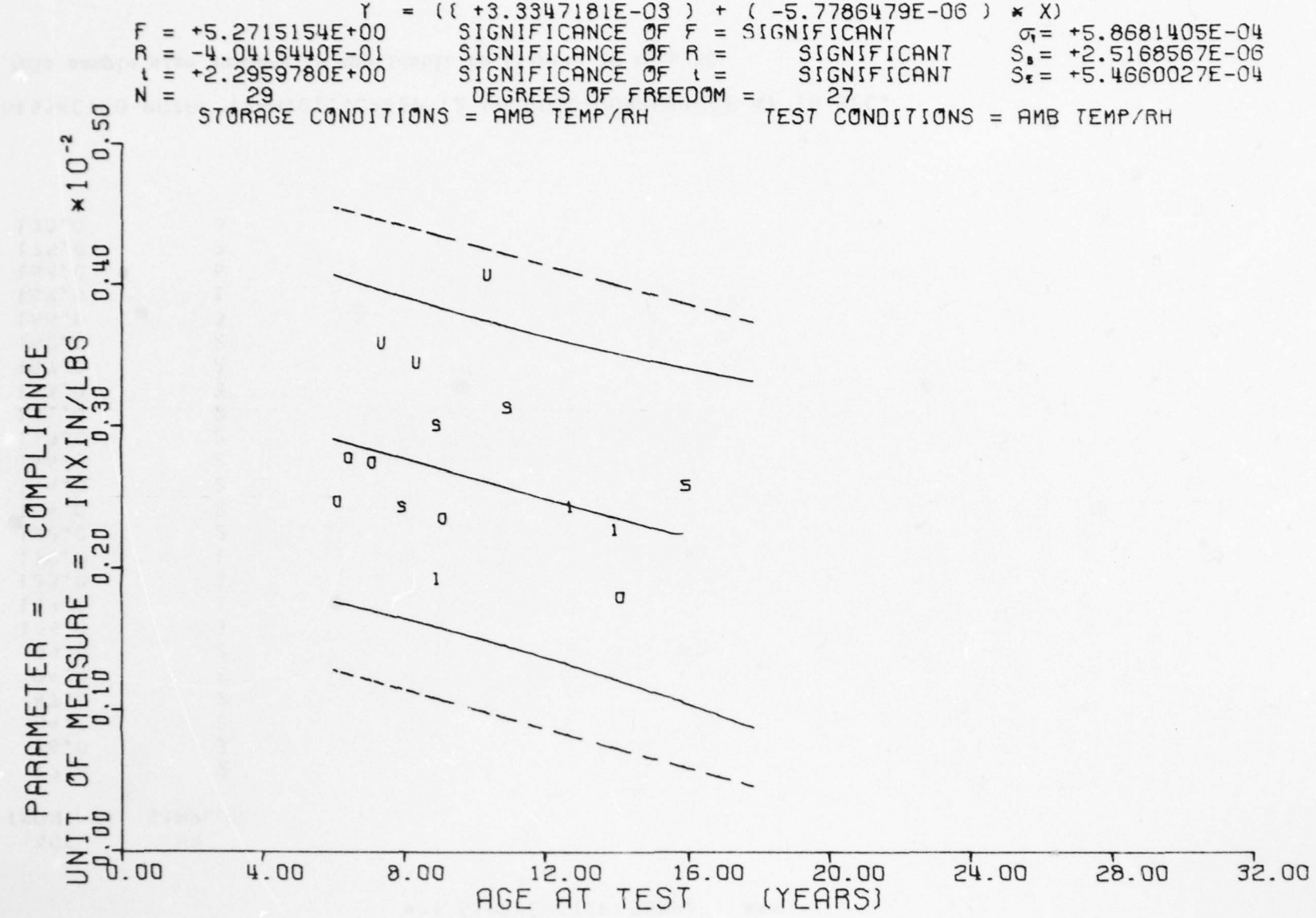
Figure 24

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES
72.0	2
76.0	3
84.0	2
87.0	2
94.0	2
99.0	2
106.0	3
108.0	1
123.0	1
130.0	1
151.0	1
166.0	3
168.0	3
190.0	3

DISSECTED MOTOR TP-H1011,CREEP 10 LB LOAD,COMPLIANCE AT 10,000 SEC.

This sample size summary is applicable to figure 25.



DISSECTED MOTOR TP-H1011, CREEP 10 LB LOAD, COMPLIANCE AT 10,000 SEC.

Figure 25

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES
72.0	2
76.0	3
84.0	2
87.0	2
94.0	2
99.0	2
106.0	3
108.0	1
123.0	1
130.0	1
132.0	2
134.0	2
144.0	2
146.0	2
149.0	2
151.0	2
153.0	3
157.0	2
160.0	2
166.0	3
167.0	1
168.0	6
175.0	2
190.0	3

DISSECTED MOTOR TP-H1011,CREEP 12 LB LOAD,COMPLIANCE AT 10 SEC.

This sample size summary is applicable to figures 26 thru 28.

Y = ((+1.6931521E-03) + (-2.9228175E-06) * X)

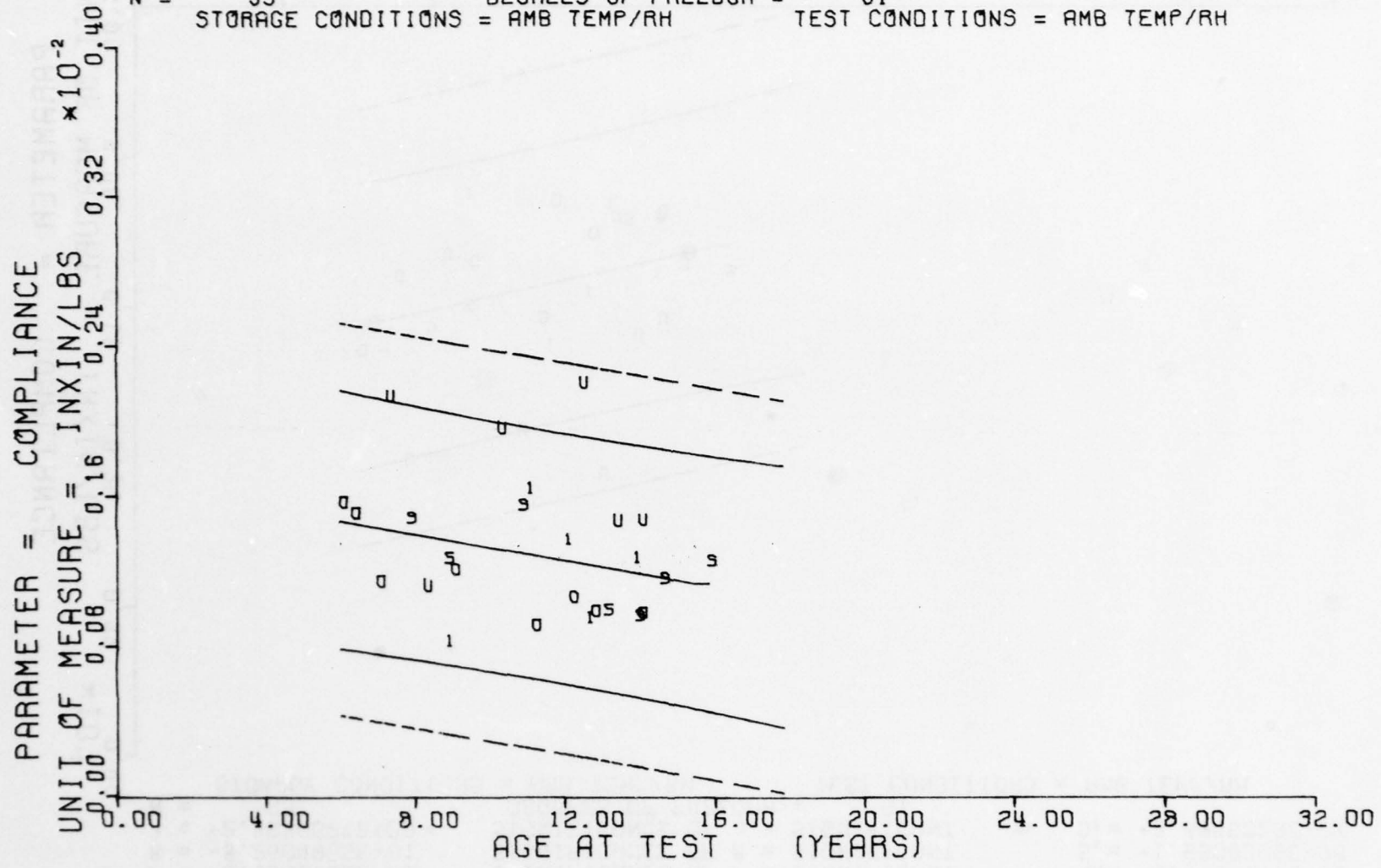
F = +4.5122739E+00 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +3.6187094E-04

R = -2.8510394E-01 SIGNIFICANCE OF R = SIGNIFICANT S_a = +1.3759541E-06

t = +2.1242113E+00 SIGNIFICANCE OF t = SIGNIFICANT S_ε = +3.5023607E-04

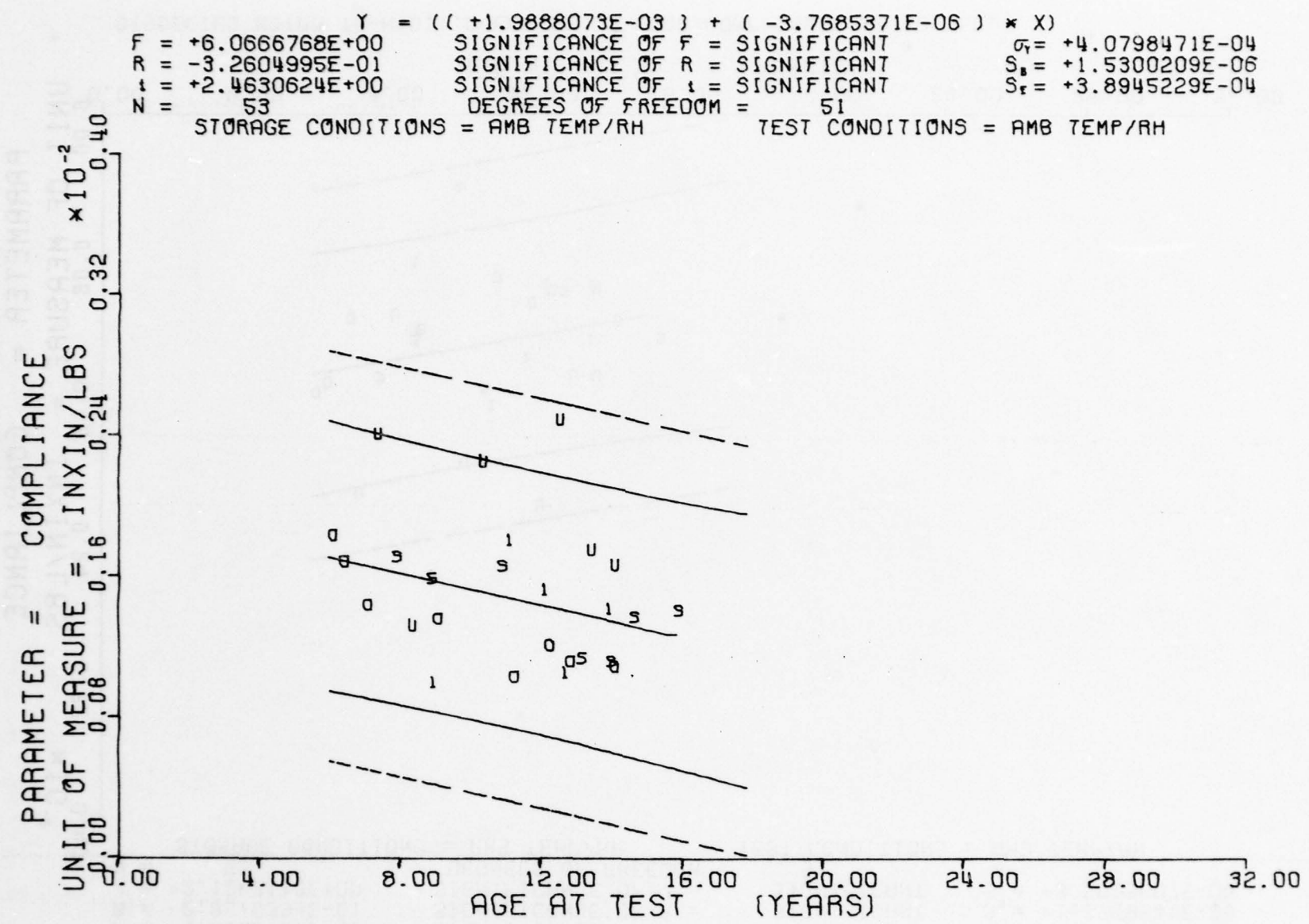
N = 53 DEGREES OF FREEDOM = 51

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



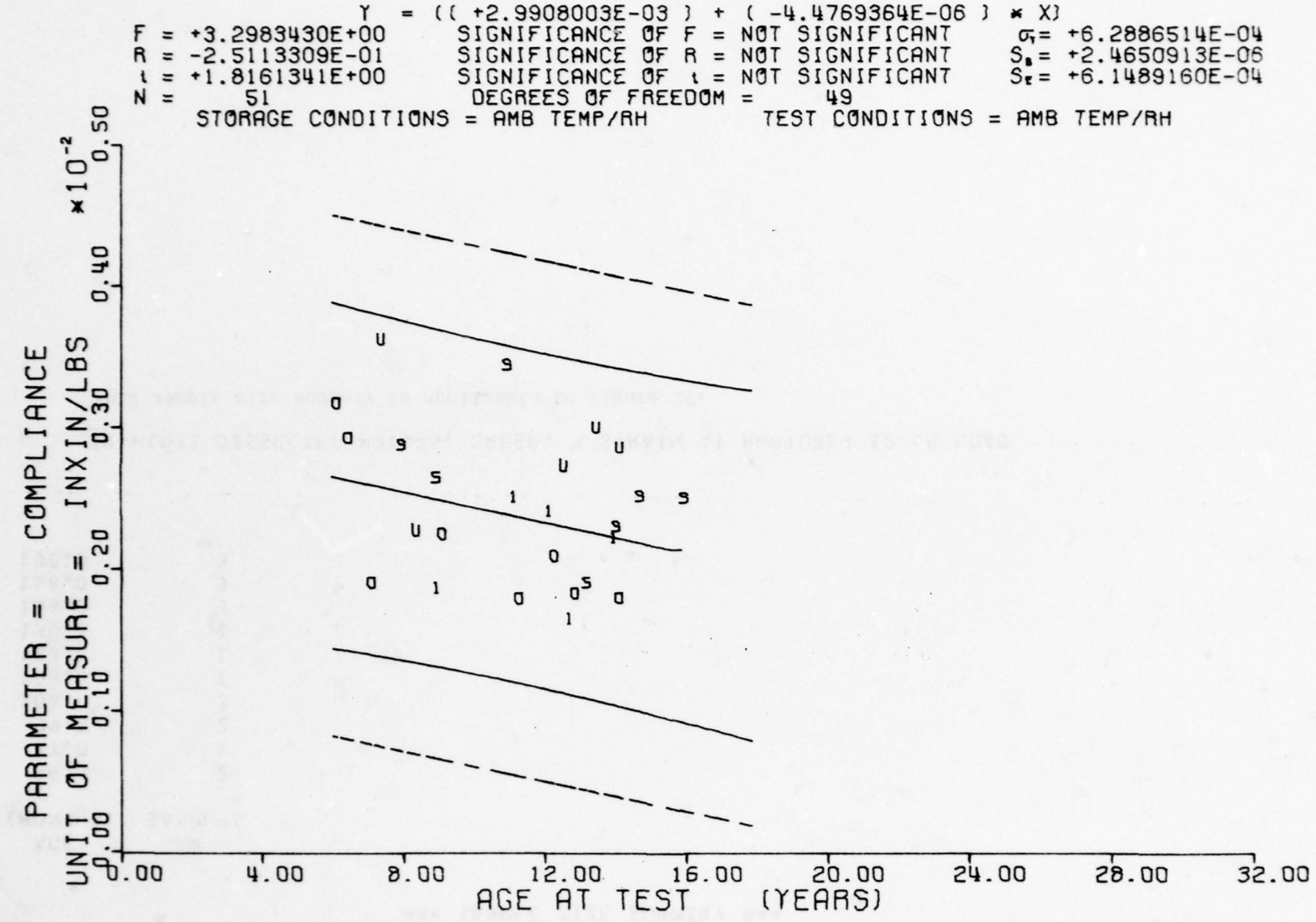
DISSECTED MOTOR TP-H1011, CREEP 12 LB LOAD, COMPLIANCE AT 10 SEC.

Figure 26



DISSECTED MOTOR TP-H1011, CREEP 12 LB LOAD, COMPLIANCE AT 20 SEC.

Figure 27



DISSECTED MOTOR TP-H1011,CREEP 12 LB LOAD,COMPLIANCE AT 1000 SEC.

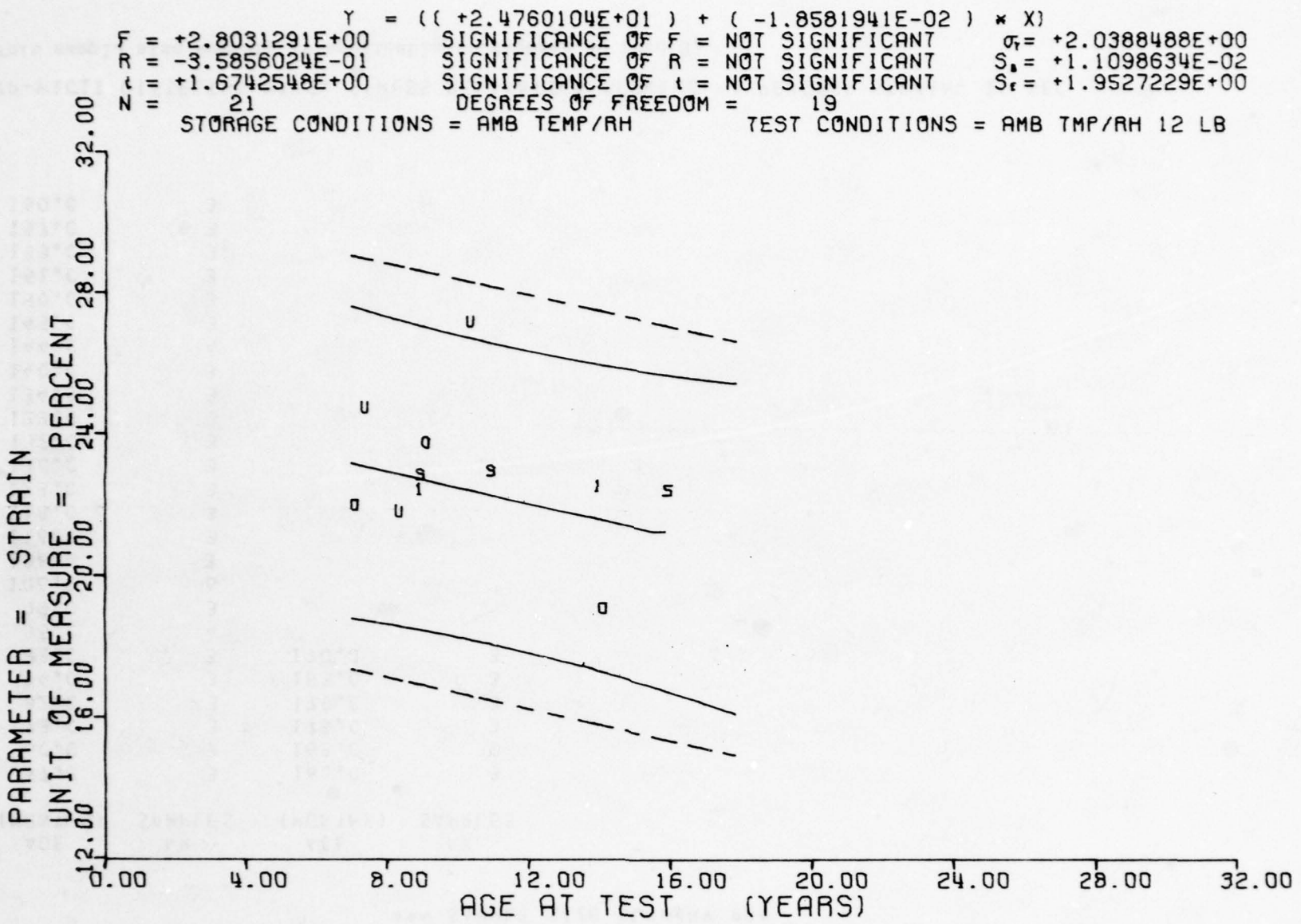
Figure 28

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES
84.0	2
87.0	2
99.0	2
106.0	3
108.0	1
123.0	1
130.0	1
166.0	3
168.0	3
190.0	3

TP-H1011 DISSECTED MOTORS, CREEP, % STRAIN AT RUPTURE, 12 LB LOAD

This sample size summary is applicable to figure 29.



TP-H1011 DISSECTED MOTORS, CREEP, % STRAIN AT RUPTURE, 12 LB LOAD

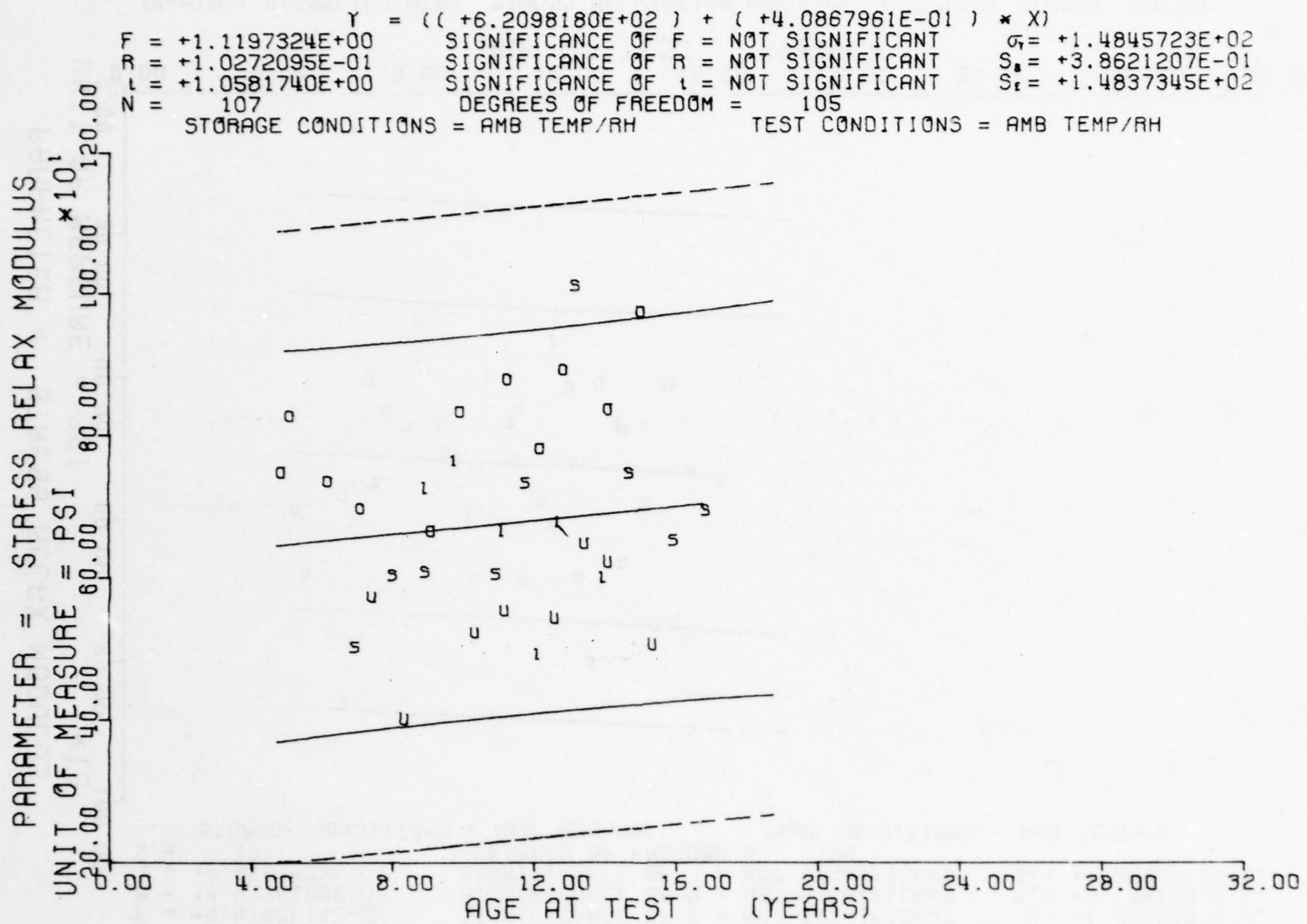
Figure 29

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES	AGE (MONTHS)	NR SAMPLES
57.0	3	166.0	3
60.0	3	168.0	9
73.0	3	175.0	3
82.0	3	179.0	3
84.0	3	183.0	3
88.0	3	190.0	3
95.0	4		
99.0	3		
106.0	6		
108.0	3		
116.0	3		
118.0	3		
123.0	3		
130.0	3		
132.0	3		
133.0	3		
134.0	3		
140.0	3		
144.0	4		
145.0	3		
150.0	3		
151.0	3		
153.0	3		
157.0	3		
160.0	3		

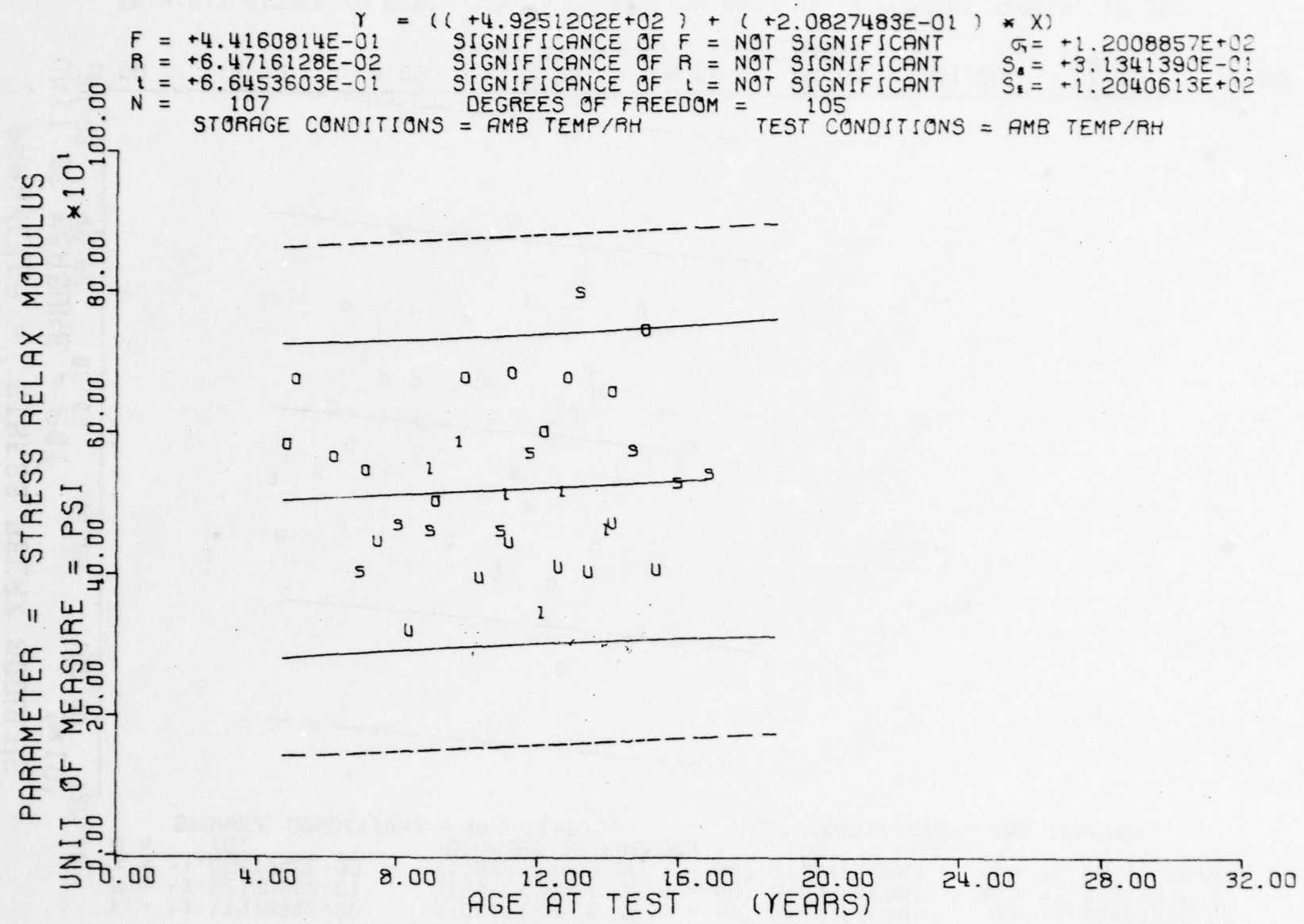
TP-H1011 DISSECTED MTRS, STRESS RELAXATION MODULUS, 3 PERCENT STRAIN, 10 SEC

This sample size summary is applicable to figures 30 thru 33.



TP-H1011 DISSECTED MTRS, STRESS RELAXATION MODULUS, 3 PERCENT STRAIN, 10 SEC

Figure 30



TP-H1011 DISSECTED MTRS, STRESS RELAXATION MODULUS, 3 PERCENT STRAIN, 50 SEC

Figure 31

Y = ((+4.5845875E+02) + (+1.8199171E-01) * X)

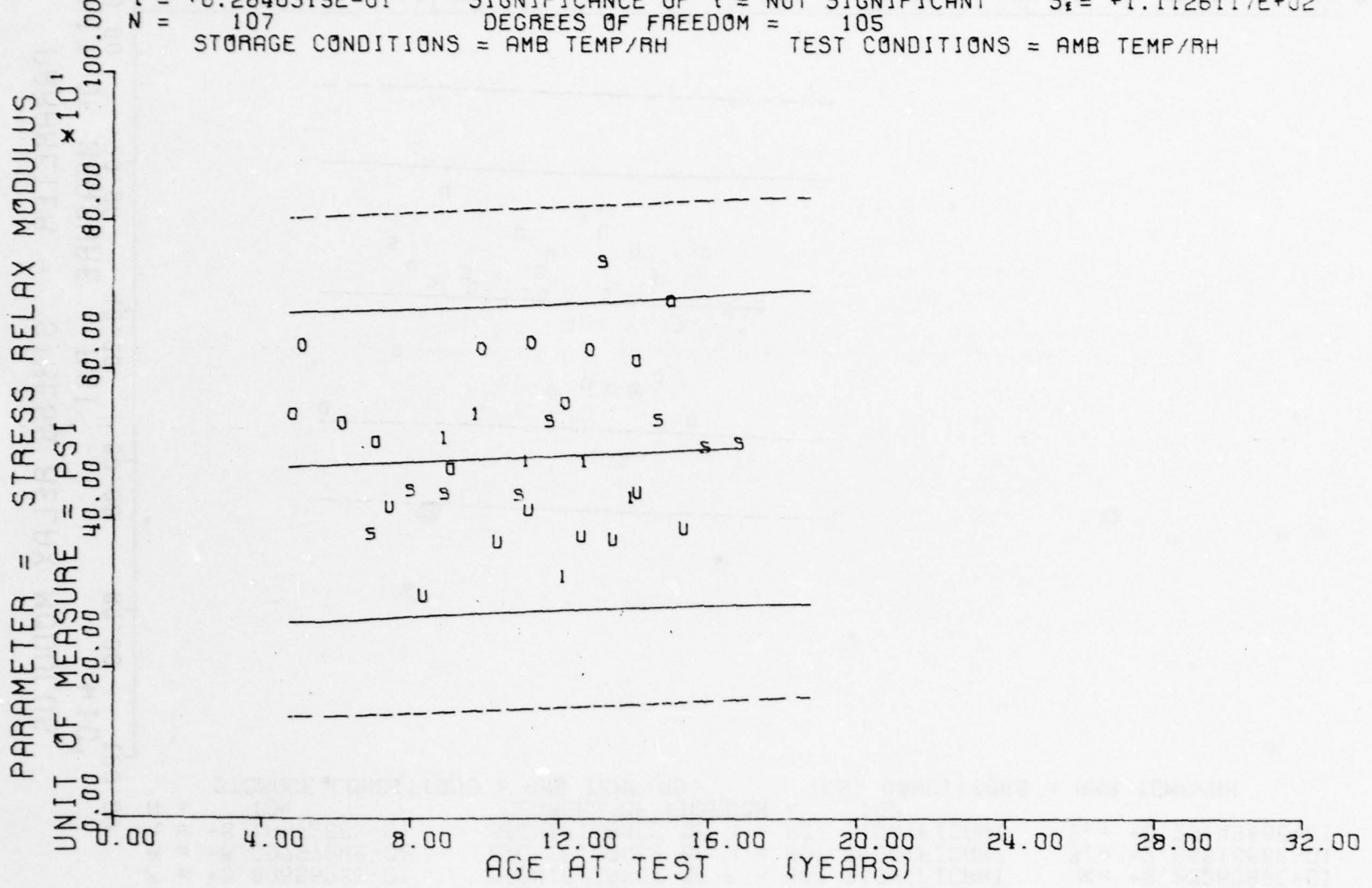
F = +3.9489052E-01 SIGNIFICANCE OF F = NOT SIGNIFICANT σ_Y = +1.1094314E+02

R = +6.1210873E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT S_B = +2.8960981E-01

t = +6.2840315E-01 SIGNIFICANCE OF t = NOT SIGNIFICANT S_E = +1.1126117E+02

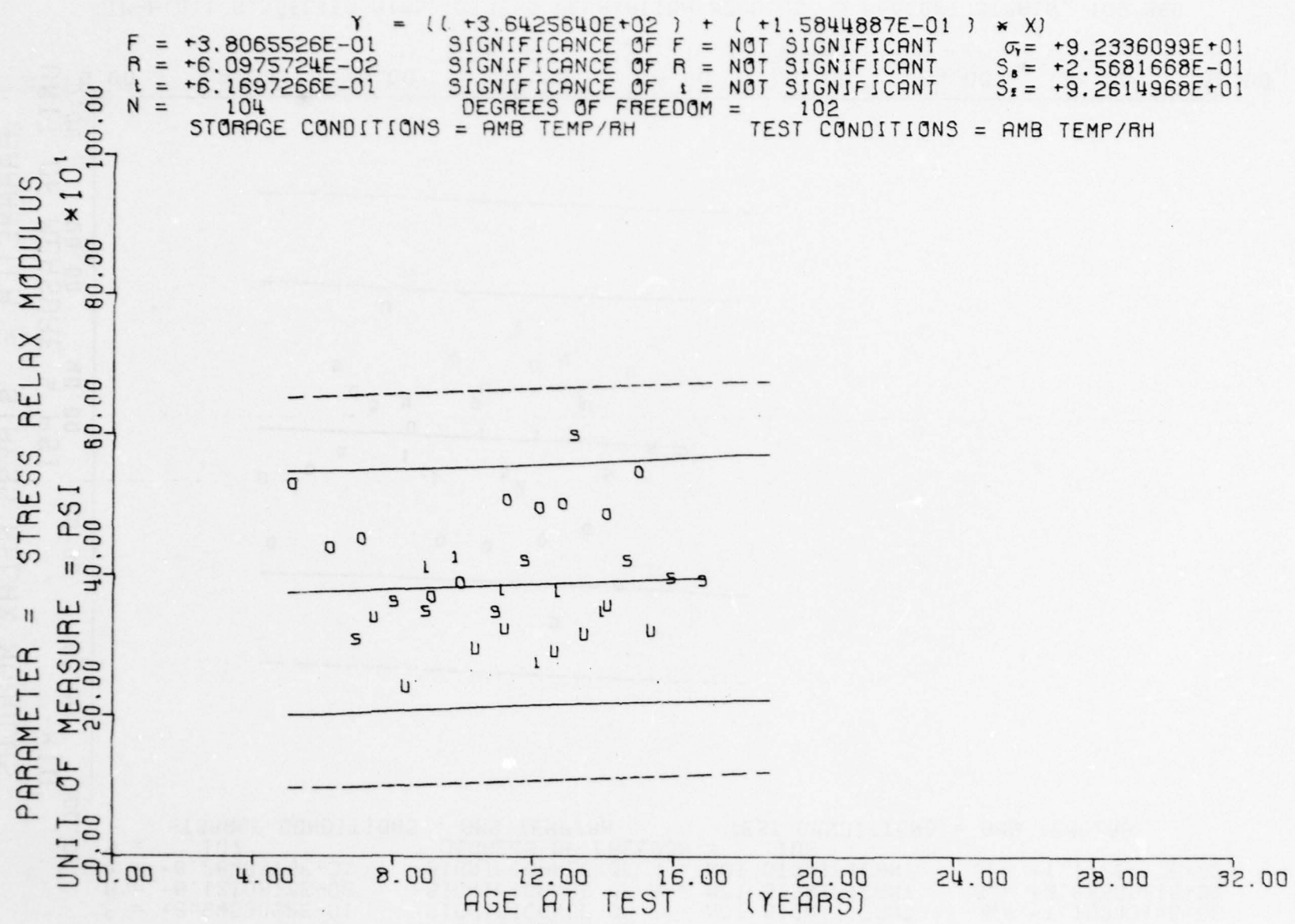
N = 107 DEGREES OF FREEDOM = 105

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



TP-H1011 DISSECTED MTRS, STRESS RELAXATION MODULUS, 3 PERCENT STRAIN, 100 SEC

Figure 32



TP-H1011 DISSECTED MTRS, STRESS RELAXATION MODULUS, 3 PERCENT STRAIN, 1000 SEC

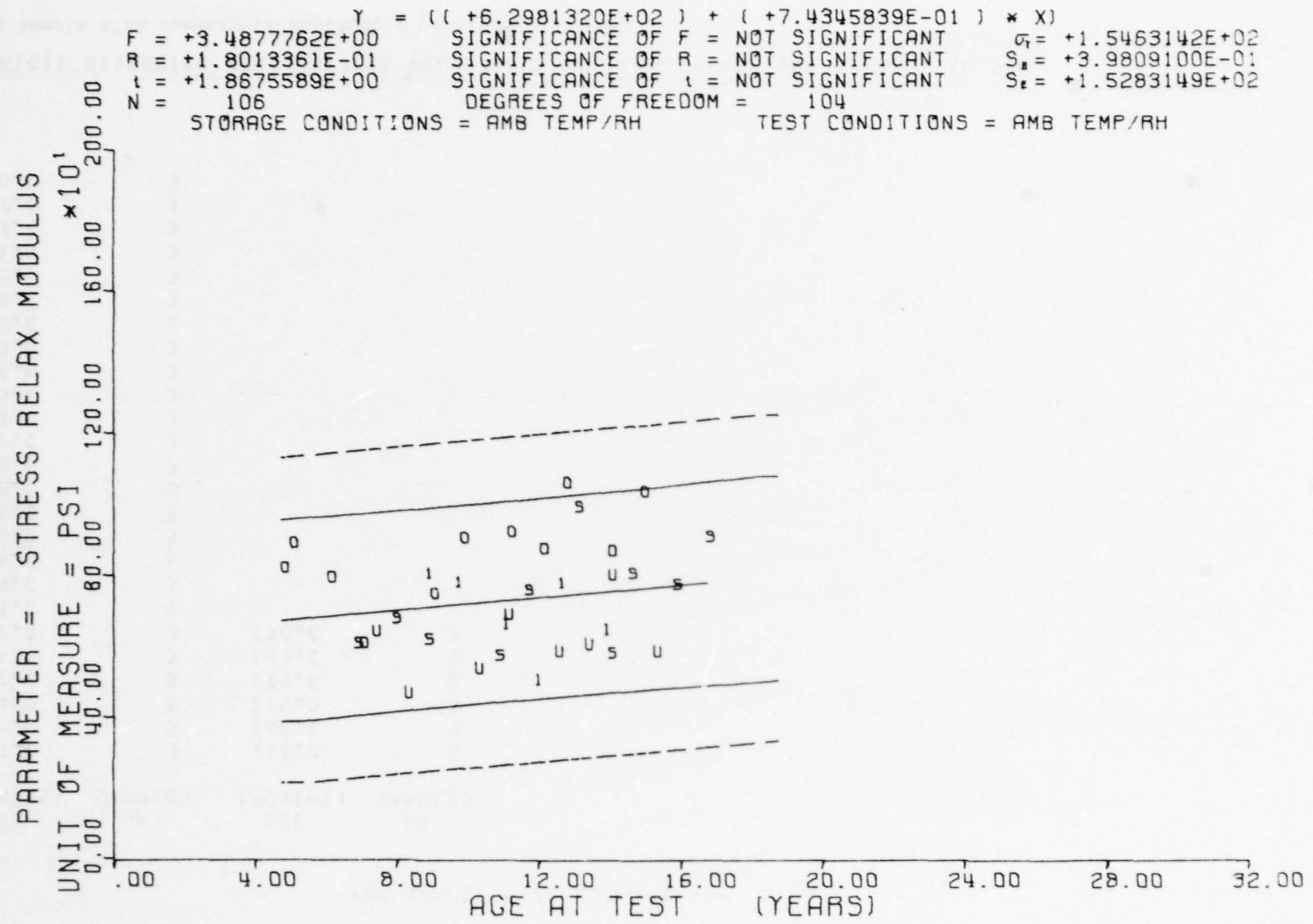
Figure 33

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES	AGE (MONTHS)	NR SAMPLES
57.C	3	166.C	3
60.C	3	168.C	9
73.C	3	175.C	3
82.C	3	179.C	3
84.C	3	183.C	3
88.C	3	190.C	3
95.C	4		
99.C	3		
106.C	6		
108.C	3		
116.C	3		
118.C	3		
123.C	3		
130.C	3		
132.C	3		
133.C	3		
134.C	3		
140.C	3		
143.C	3		
145.C	3		
150.C	3		
151.C	3		
153.C	3		
157.C	3		
160.C	3		

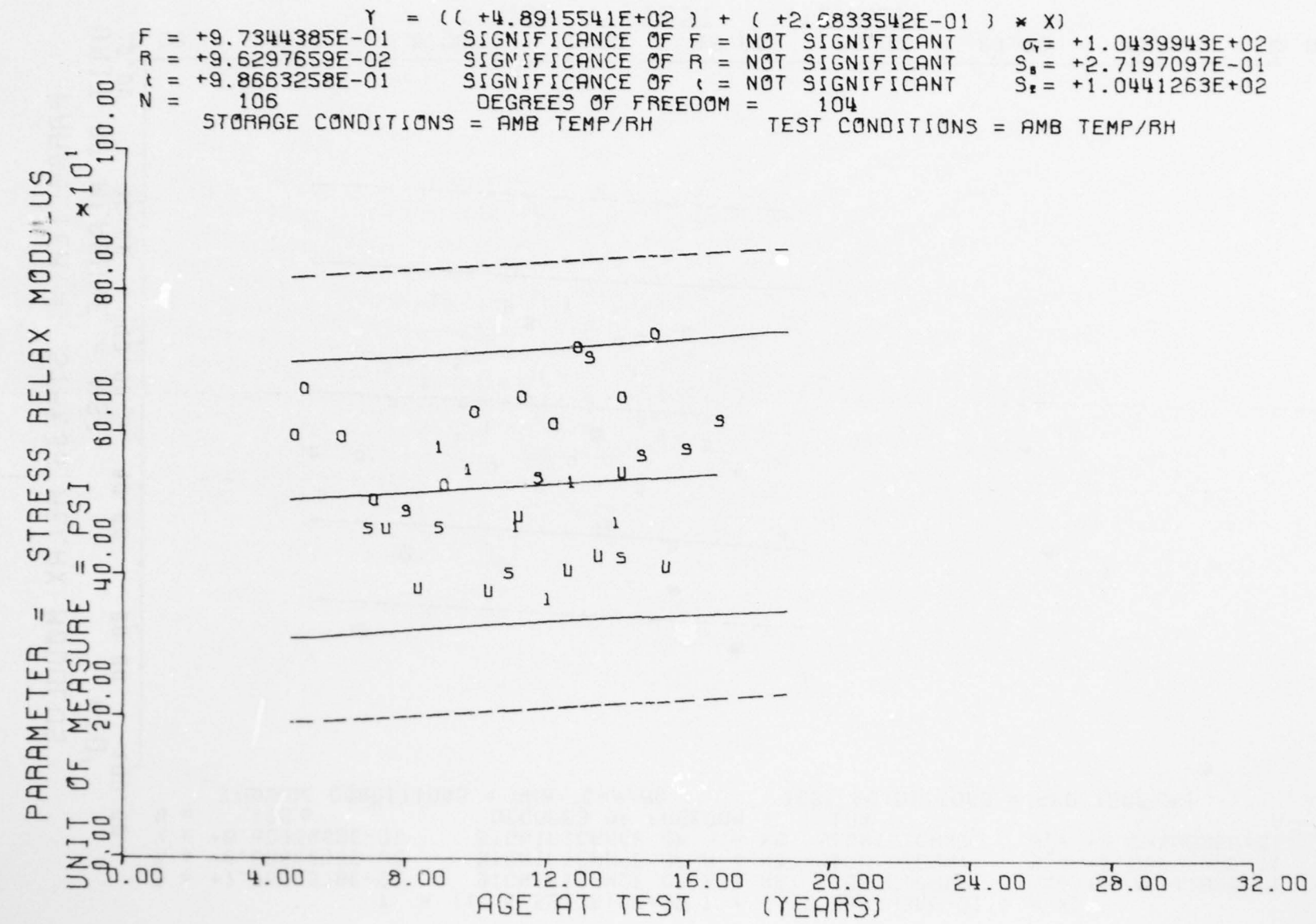
TP-H1011 DISSECTED MTRS, STRESS RELAXATICN MODULUS, 5 PERCENT STRAIN, 10 SEC

This sample size summary is applicable to figures 34 thru 37.



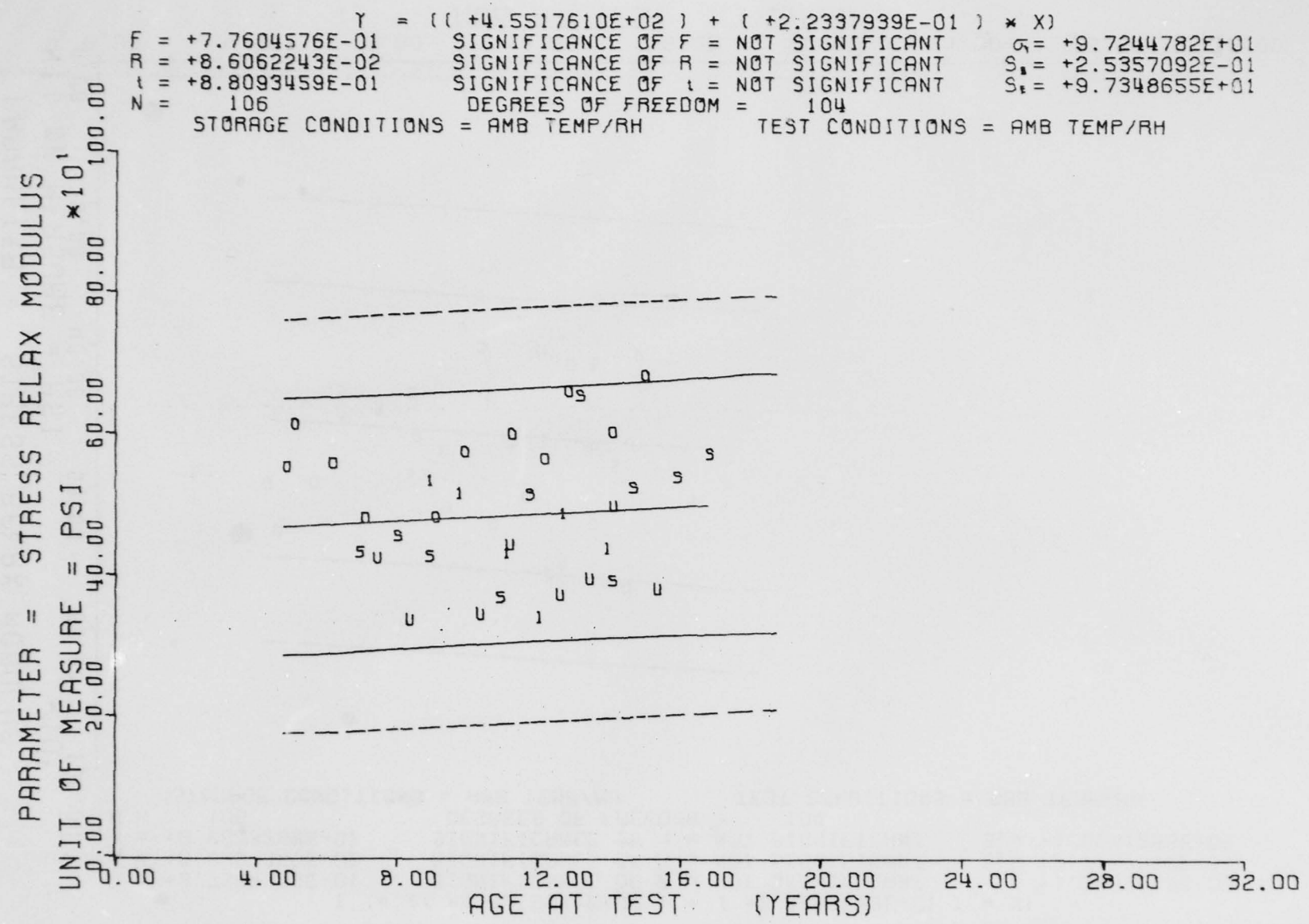
TP-H1011 DISSECTED MTRS, STRESS RELAXATION MODULUS, 5 PERCENT STRAIN, 10 SEC

Figure 34



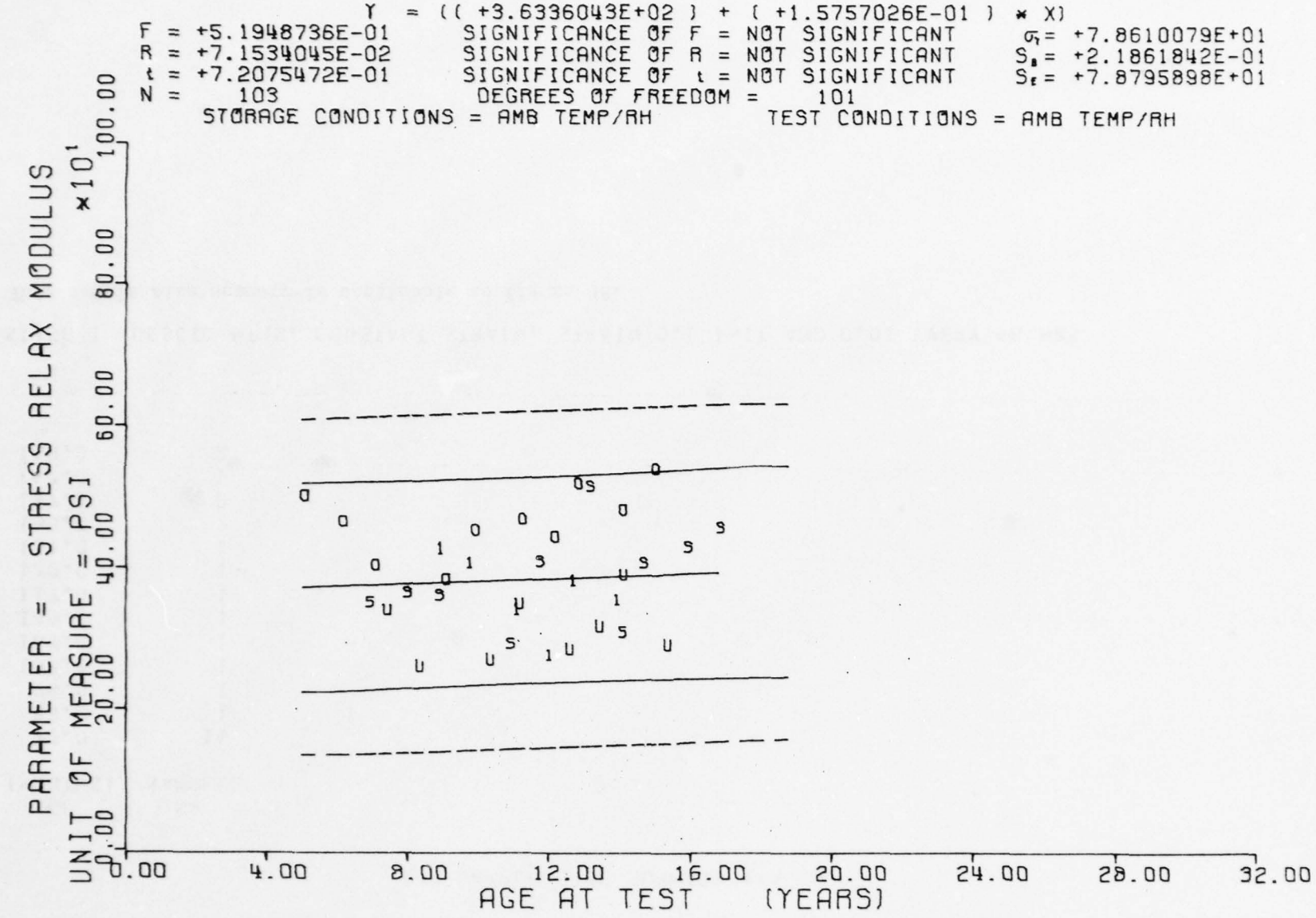
TP-H1011 DISSECTED MTRS, STRESS RELAXATION MODULUS, 5 PERCENT STRAIN, 50 SEC

Figure 35



TP-H1011 DISSECTED MTRS, STRESS RELAXATION MODULUS, 5 PERCENT STRAIN, 100 SEC

Figure 36



TP-H1011 DISSECTED MTAS, STRESS RELAXATION MODULUS, 5 PERCENT STRAIN, 1000 SEC

Figure 37

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES
72.0	16
83.0	1
94.0	1
105.0	1
107.0	1
109.0	1
117.0	1
120.0	1
131.0	1
135.0	2
137.0	2
142.0	1
159.0	2

STAGE 1 DSSCTD MTRS, CONSTANT STRAIN, STRAIN 0.1 INIT AND 0.01 EVERY 48 HRS

This sample size summary is applicable to figure 38.

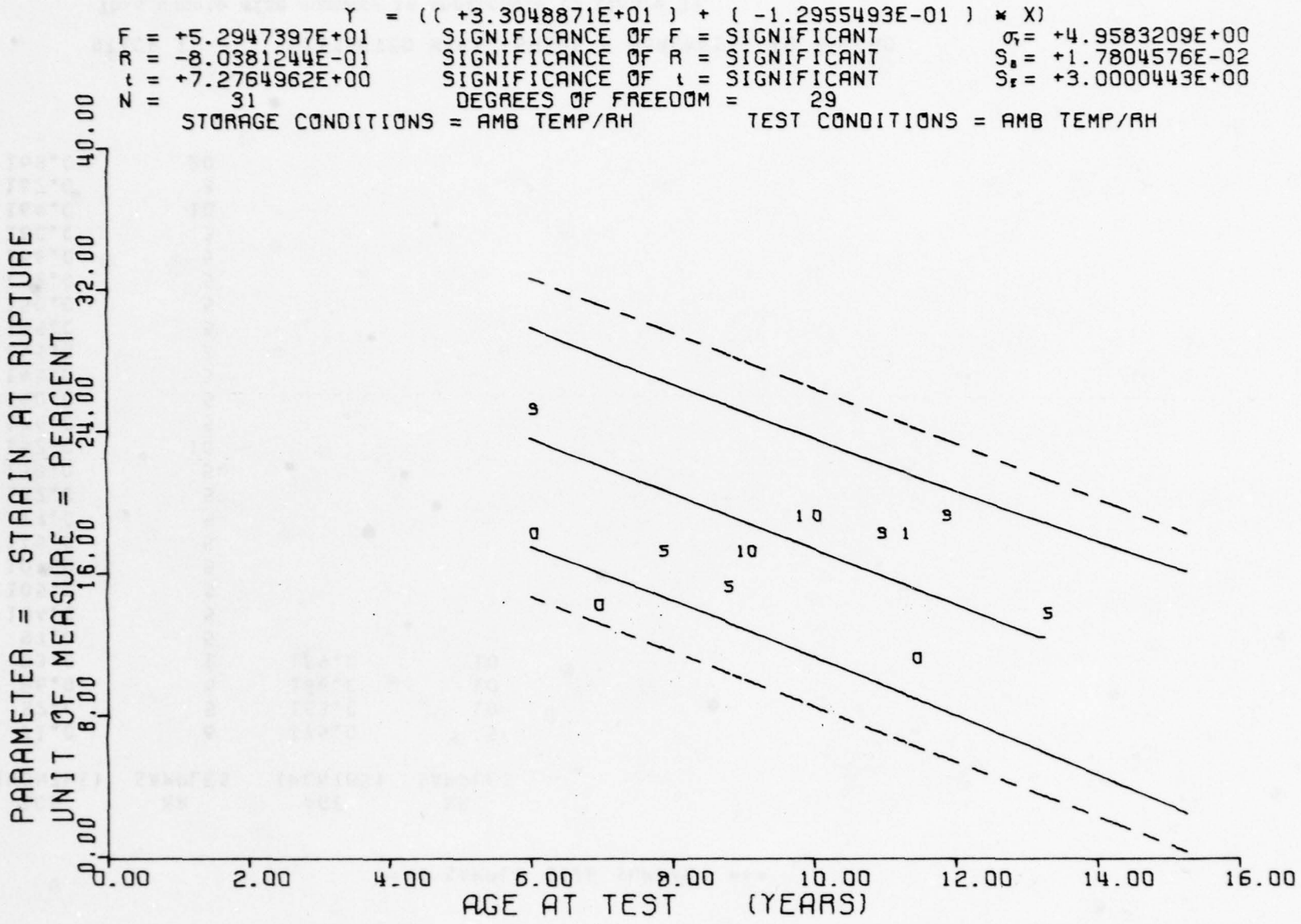

Y = ((+3.3048871E+01) + (-1.2955493E-01) * X)
F = +5.2947397E+01 SIGNIFICANCE OF F = SIGNIFICANT σr = +4.9583209E+00
R = -8.0381244E-01 SIGNIFICANCE OF R = SIGNIFICANT Sb = +1.7804576E-02
t = +7.2764962E+00 SIGNIFICANCE OF t = SIGNIFICANT Sr = +3.0000443E+00
N = 31 DEGREES OF FREEDOM = 29
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT RUPTURE
UNIT OF MEASURE = PERCENT
0.00
8.00
16.00
24.00
32.00
40.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
AGE AT TEST (YEARS)
STAGE 1 OSSCTD MTRS, CONSTANT STRAIN, STRAIN 0.1 INIT AND 0.01 EVERY 48 HRS

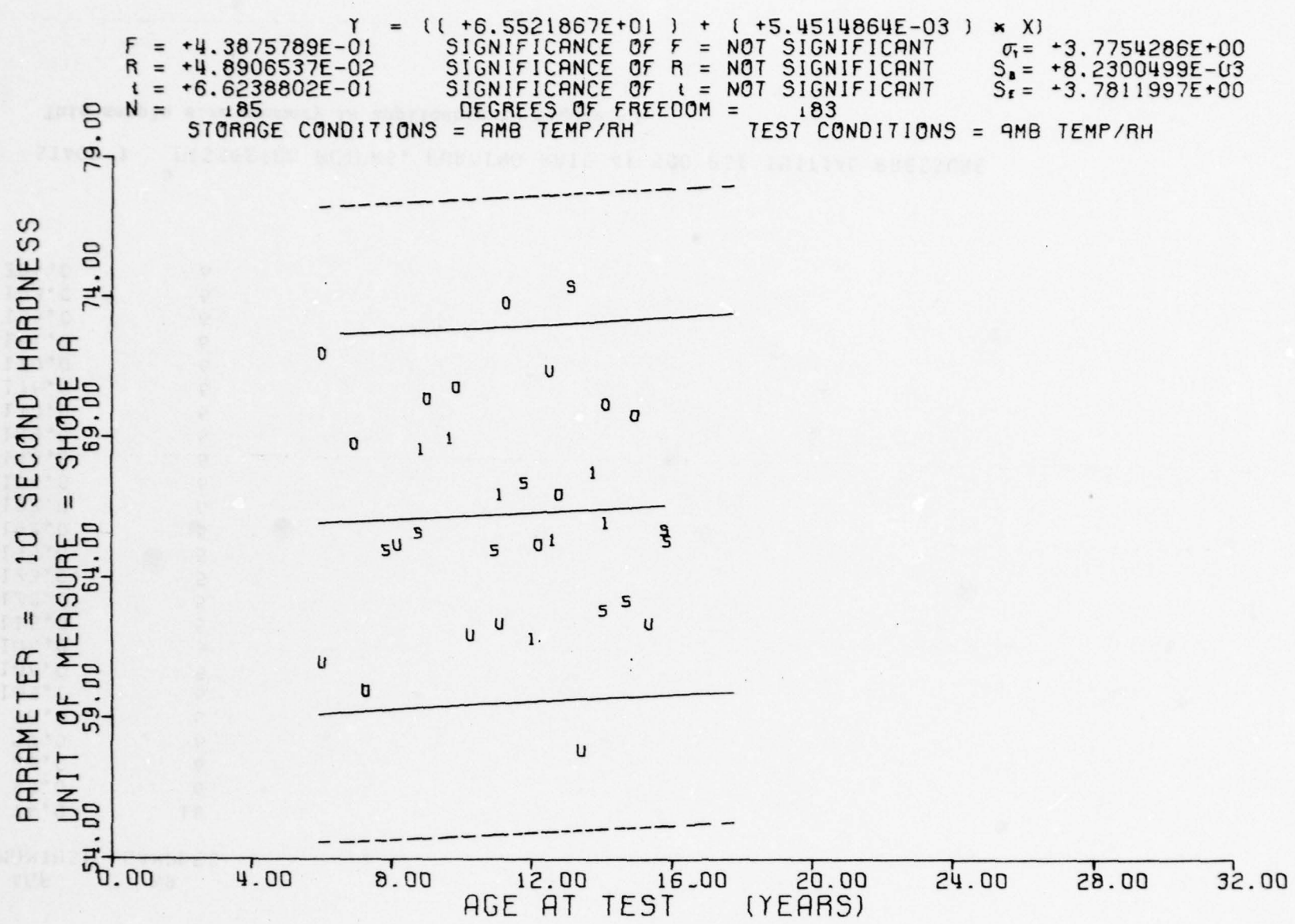
Figure 38

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES	AGE (MONTHS)	NR SAMPLES
71.0	6	175.0	5
82.0	5	183.0	10
86.0	6	188.0	10
93.0	1	189.0	10
97.0	5		
104.0	5		
105.0	5		
107.0	5		
115.0	5		
117.0	5		
122.0	5		
130.0	5		
132.0	10		
134.0	5		
140.0	5		
143.0	3		
145.0	3		
149.0	5		
150.0	5		
152.0	5		
156.0	5		
160.0	3		
164.0	10		
167.0	3		
168.0	20		

STAGE 1 DISSECTED MTRS, SHORE A HARDNESS, 10 SECOND

This sample size summary is applicable to figure 39.



STAGE 1 DISSECTED MTRS, SHORE A HARDNESS, 10 SECOND

Figure 39

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES
74.0	18
83.0	6
89.0	6
97.0	6
98.0	6
105.0	6
106.0	5
108.0	5
118.0	5
120.0	5
123.0	5
135.0	5
142.0	5
152.0	6
154.0	6
168.0	6
169.0	6
170.0	6
176.0	6
179.0	6
181.0	6
185.0	6
193.0	6
204.0	6

STAGE 1 DISSECTED MOTORS, BURNING RATE AT 500 PSI INITIAL PRESSURE

This sample size summary is applicable to figure 40.

Y = ((+2.9725563E-01) + (-3.1024938E-04) * X)

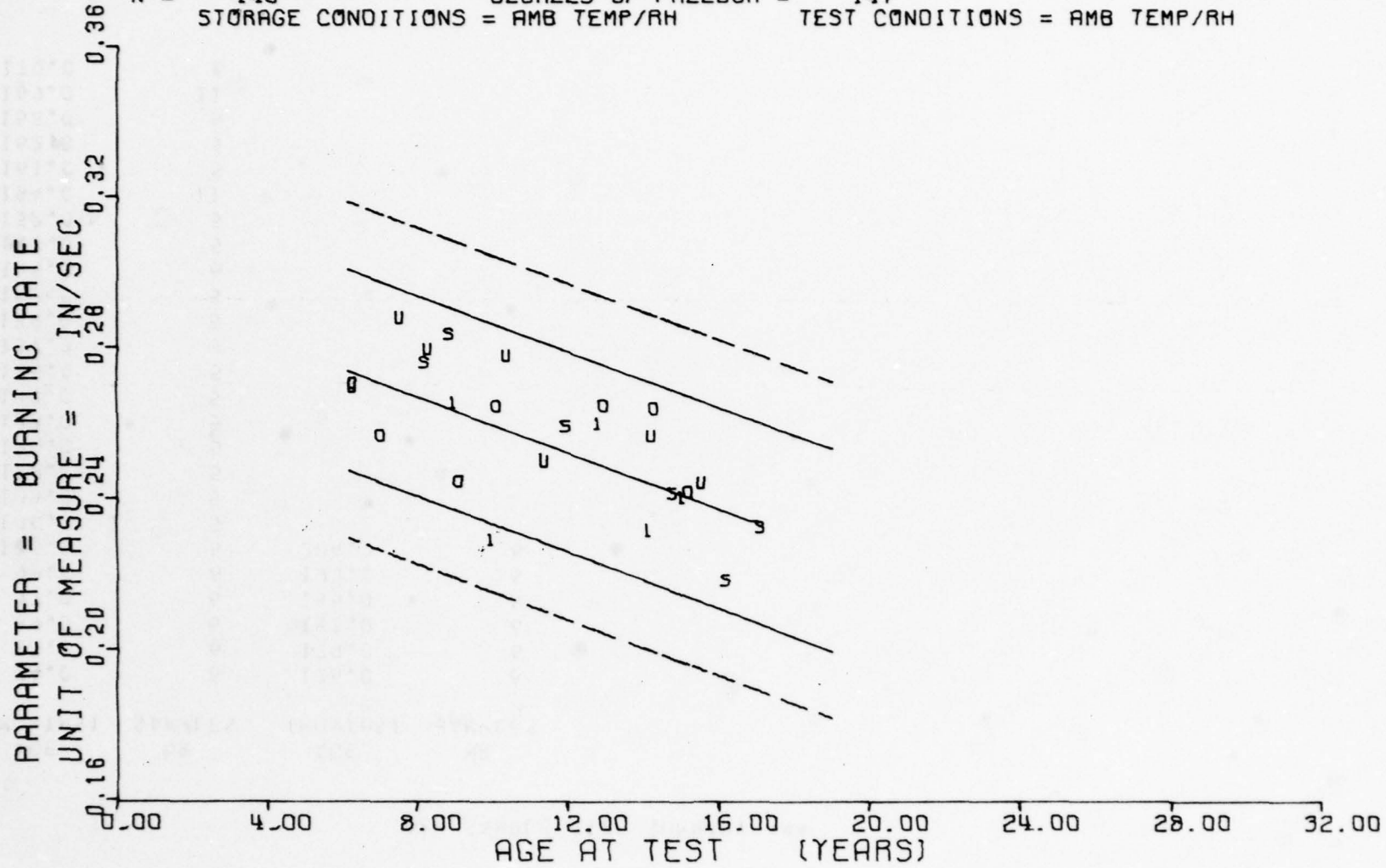
F = +1.0943720E+02 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +1.9610743E-02

R = -6.5326889E-01 SIGNIFICANCE OF R = SIGNIFICANT S_b = +2.9657083E-05

t = +1.0461223E+01 SIGNIFICANCE OF t = SIGNIFICANT S_r = +1.4898220E-02

N = 149 DEGREES OF FREEDOM = 147

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



STAGE 1 DISSECTED MOTORS, BURNING RATE AT 500 PSI INITIAL PRESSURE

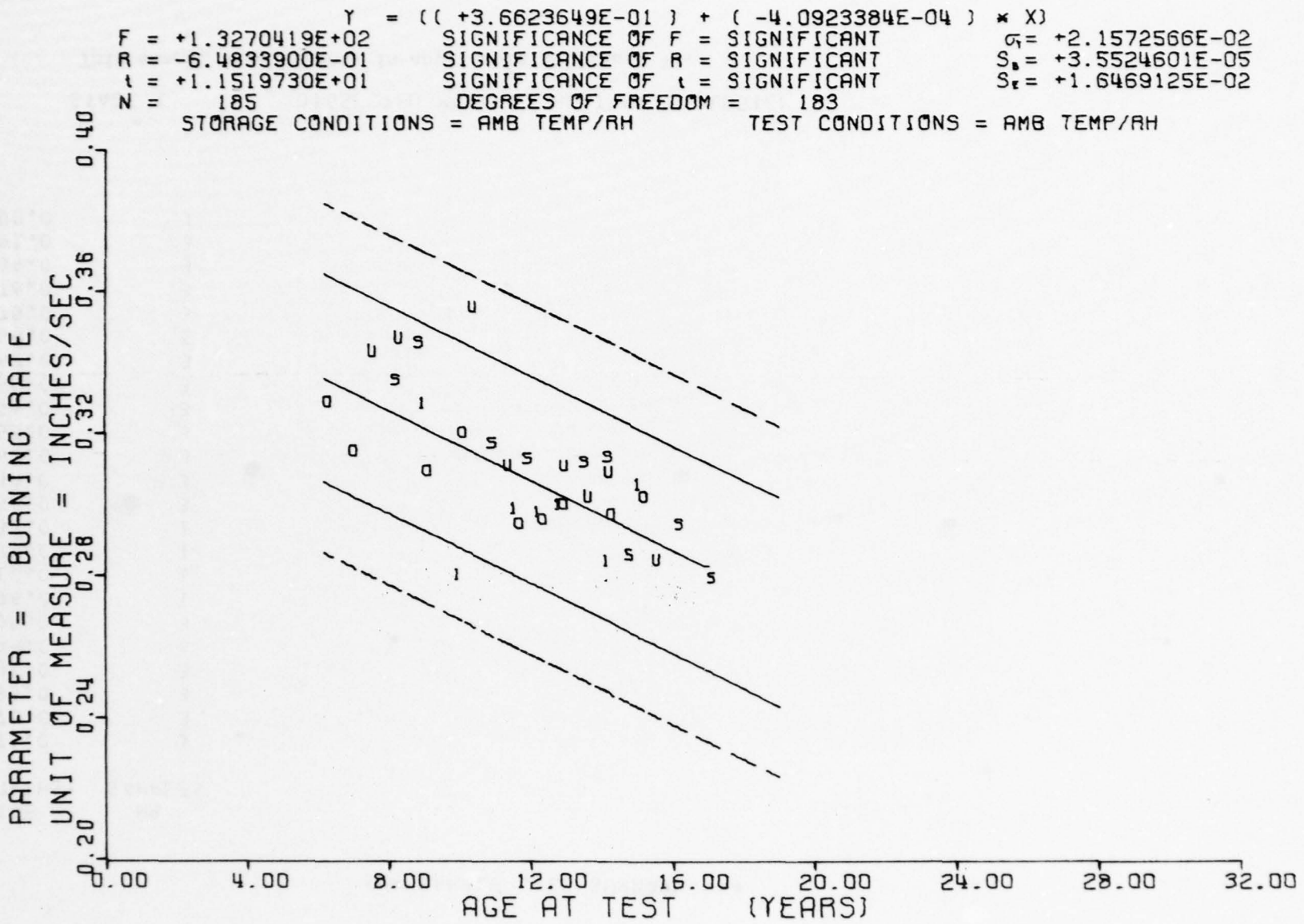
Figure 40

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES	AGE (MONTHS)	NR SAMPLES
74.0	6	176.0	6
83.0	6	179.0	6
89.0	6	181.0	6
97.0	6	185.0	6
98.0	6	193.0	6
105.0	6	204.0	6
106.0	5		
108.0	5		
118.0	5		
120.0	5		
123.0	5		
130.0	5		
135.0	5		
137.0	8		
139.0	5		
142.0	5		
145.0	6		
147.0	5		
152.0	5		
154.0	11		
161.0	5		
162.0	5		
168.0	6		
169.0	11		
170.0	6		

STAGE 1 DISSECTED MOTORS, BURNING RATE AT 1000 PSI INITIAL PRESSURE

This sample size summary is applicable to figure 41.



STAGE 1 DISSECTED MOTORS, BURNING RATE AT 1000 PSI INITIAL PRESSURE

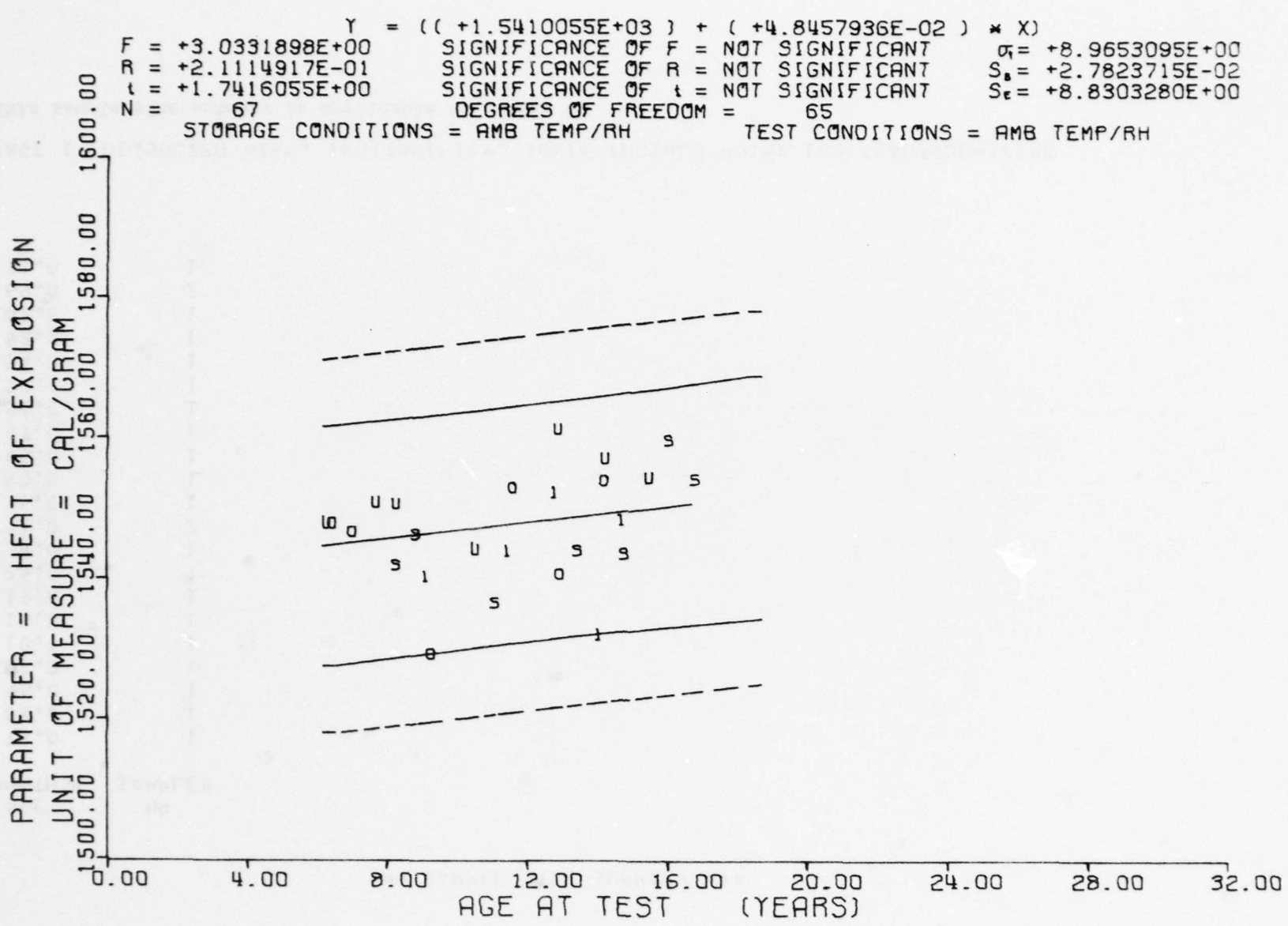
Figure 41

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES
74.0	3
76.0	3
83.0	3
91.0	3
98.0	6
105.0	3
108.0	1
110.0	1
125.0	1
132.0	1
136.0	3
138.0	3
152.0	3
153.0	3
154.0	3
160.0	3
167.0	3
169.0	6
175.0	3
176.0	3
184.0	3
191.0	3
200.0	3

STAGE 1 DISSECTED MOTORS, HEAT OF EXPLOSION

This sample size summary is applicable to figure 42.



STAGE 1 DISSECTED MOTORS, HEAT OF EXPLOSION

Figure 42

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES
73.0	1
88.0	1
96.0	1
108.0	1
110.0	1
116.0	1
118.0	1
125.0	1
133.0	1
134.0	2
136.0	1
140.0	1
145.0	1
147.0	1
151.0	1
152.0	1
154.0	1
158.0	1
162.0	1
169.0	2
176.0	1

STAGE 1 DISSECTED MTRS, IGNITABILITY, IGNTN THRSHLD POINT 168 (CAL/SQCM)/SEC

This sample size summary is applicable to figure 43.

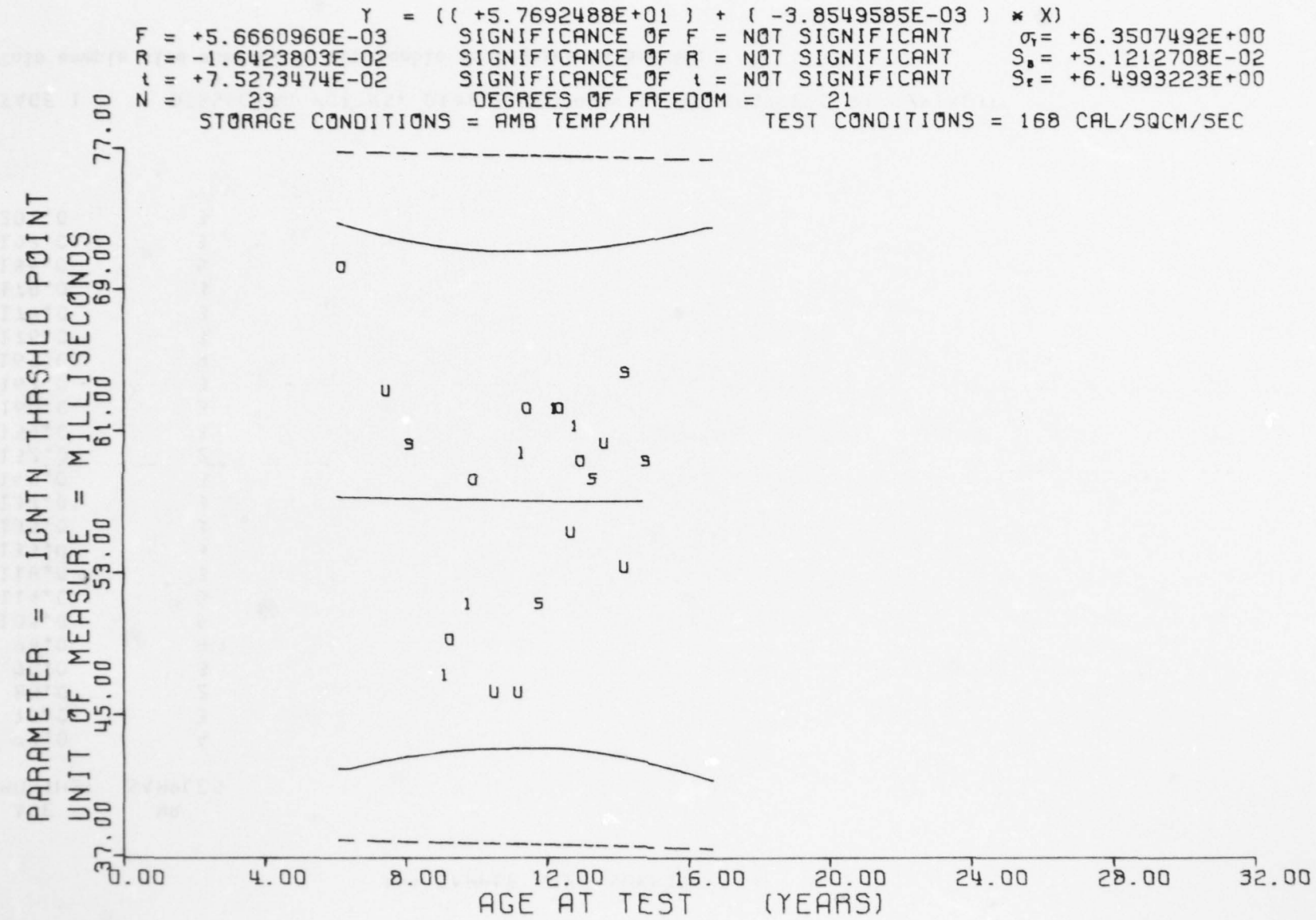

Y = ((+5.7692488E+01) + (-3.8549585E-03) * X)
F = +5.6660960E-03 SIGNIFICANCE OF F = NOT SIGNIFICANT σ_Y = +6.3507492E+00
R = -1.6423803E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT S_B = +5.1212708E-02
t = +7.5273474E-02 SIGNIFICANCE OF t = NOT SIGNIFICANT S_E = +6.4993223E+00
N = 23 DEGREES OF FREEDOM = 21
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 168 CAL/SQCM/SEC
PARAMETER = IGNTN THRSHLD POINT
UNIT OF MEASURE = MILLISECONDS
77.00
69.00
61.00
53.00
45.00
37.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MTRS, IGNITABILITY, IGNTN THRSHLD POINT 168 (CAL/SQCM)/SEC

Figure 43

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES
73.0	4
75.0	3
83.0	2
90.0	3
98.0	9
105.0	5
114.0	3
118.0	3
133.0	3
135.0	3
137.0	3
140.0	3
152.0	2
154.0	3
160.0	3
167.0	3
169.0	9
176.0	3
177.0	3
179.0	3
184.0	5
192.0	3
201.0	3

STAGE 1 DISSECTED MOTORS, DTA, ENDOTHERM 1, 12 DEGREE C RISE/MINUTE

This sample size summary is applicable to figures 44 and 45.

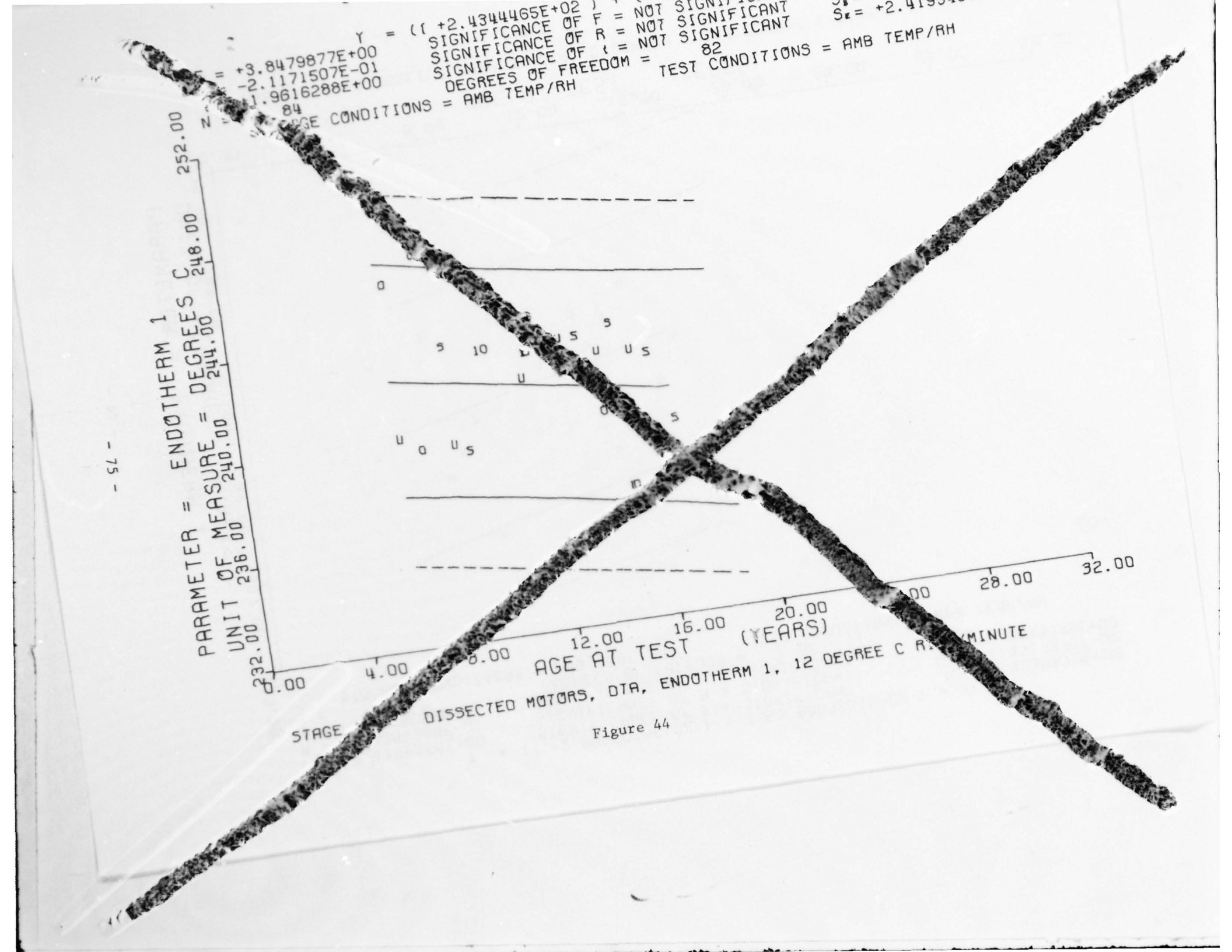
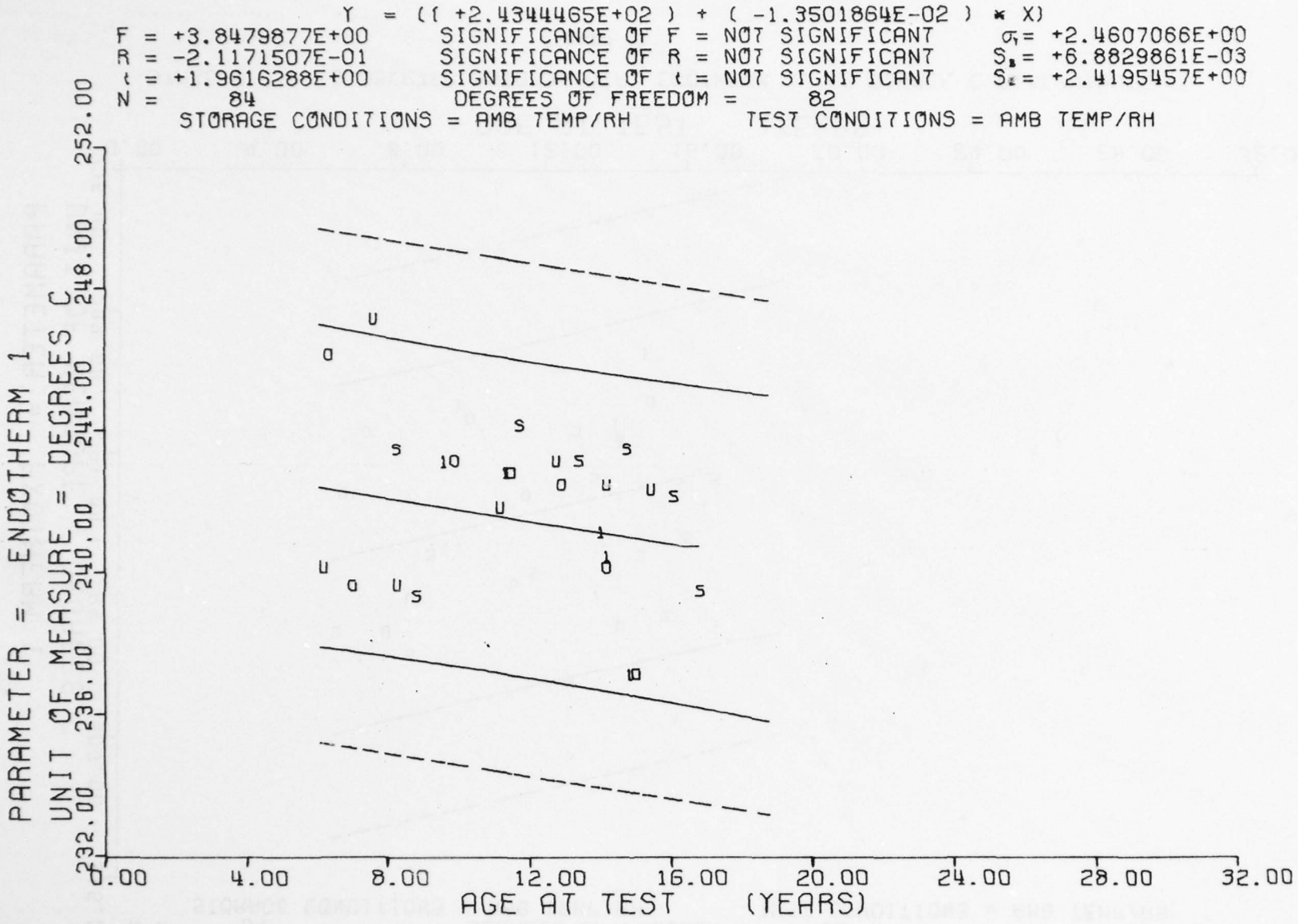
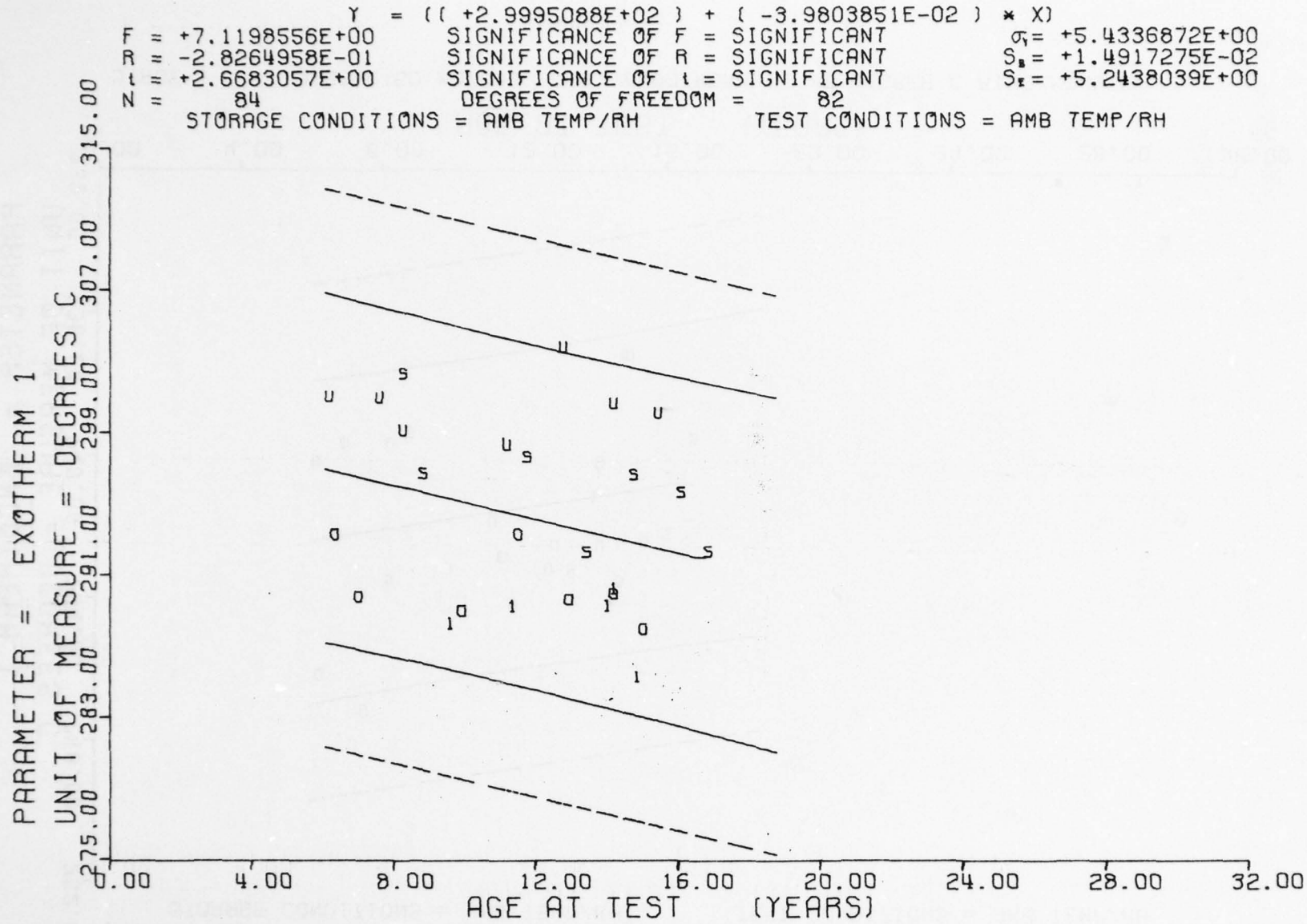

Y = ((+2.4344465E+02
= +3.8479877E+00
-2.1171507E-01
1.9616288E+00
84
SIGNIFICANCE OF F = NOT SIGNIFICANT
SIGNIFICANCE OF R = NOT SIGNIFICANT
SIGNIFICANCE OF t = NOT SIGNIFICANT
DEGREES OF FREEDOM = 82
GE CONDITIONS = AMB TEMP/RH
TEST CONDITIONS = AMB TEMP/RH
PARAMETER = ENDOTHERM 1
UNIT OF MEASURE = DEGREES C
252.00
248.00
244.00
240.00
236.00
232.00
0.00
4.00
8.00
12.00
16.00
20.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE
DISSECTED MOTORS, DTA, ENDOTHERM 1, 12 DEGREE C R.
MINUTE

Figure 44



STAGE 1 DISSECTED MOTORS, DTA, ENDOTHERM 1, 12 DEGREE C RISE/MINUTE

Figure 44



STAGE 1 DISSECTED MOTORS, DTA, EXOTHERM 1, 12 DEGREE C RISE/MINUTE

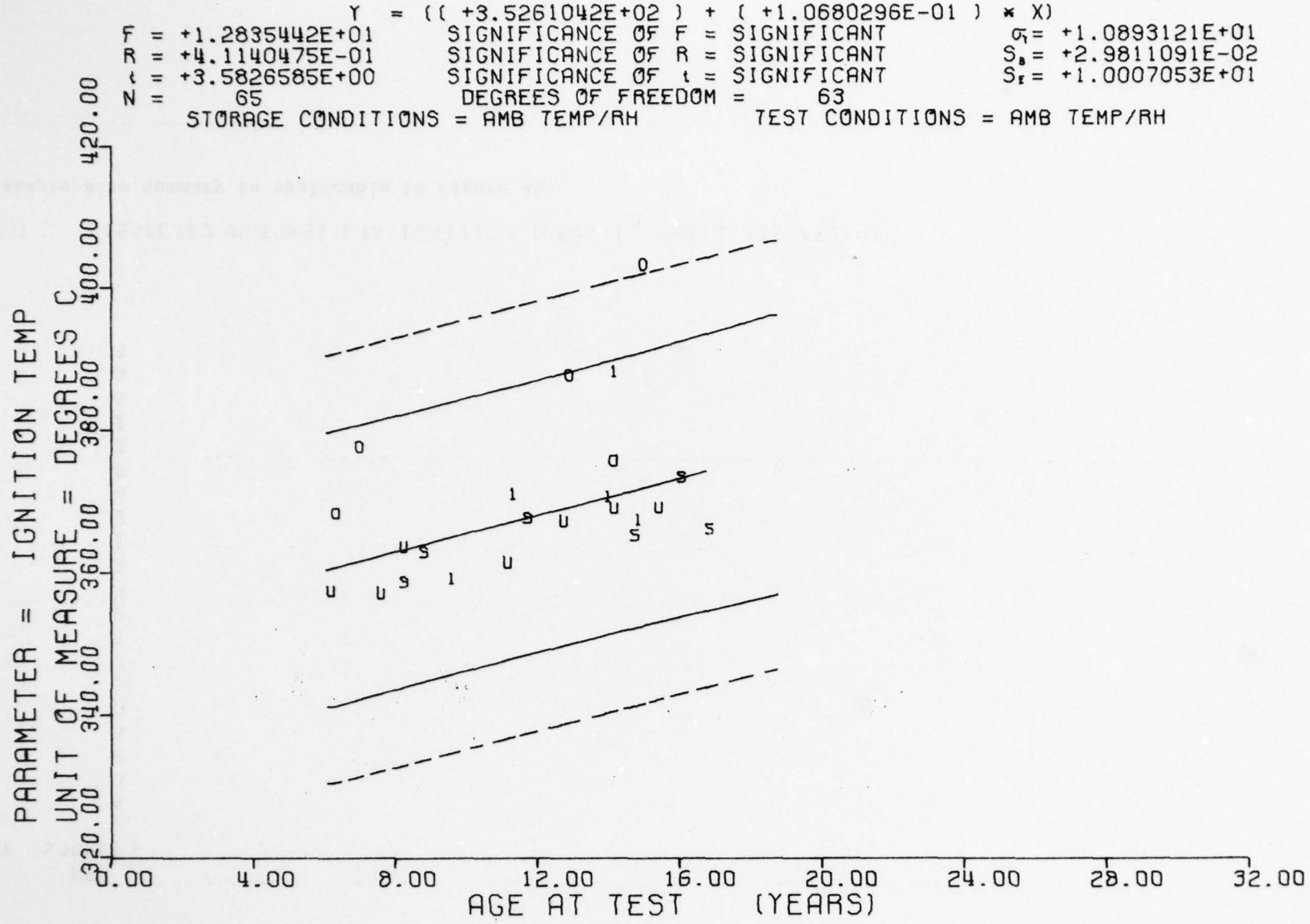
Figure 45

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES
73.0	4
75.0	3
83.0	2
90.0	3
98.0	9
105.0	5
114.0	2
133.0	3
135.0	2
140.0	3
152.0	2
154.0	1
167.0	2
169.0	6
176.0	2
177.0	3
179.0	2
184.0	5
192.0	3
201.0	3

STAGE 1 DISSECTED MOTORS, DTA IGNITION TEMP, 12 DEG C RISE/MINUTE

This sample size summary is applicable to figure 46.



STAGE 1 DISSECTED MOTORS, DTA IGNITION TEMP, 12 DEG C RISE/MINUTE

Figure 46

*** SAMPLE SIZE SUMMARY ***

AGE (MONTHS)	NR SAMPLES
133.0	4
135.0	4
146.0	4
148.0	4
150.0	4
152.0	4
154.0	4
157.0	4
163.0	4
167.0	6
169.0	4
170.0	4
175.0	4
184.0	6
191.0	6

DISSECTED MTR, STAGE 1, TP-H1C11, SOL GEL, PERCENT EXTRACTABLES

This sample size summary is applicable to figures 47 thru 50.

Y = ((+8.0798083E+00) + (-6.2924187E-03) * X)

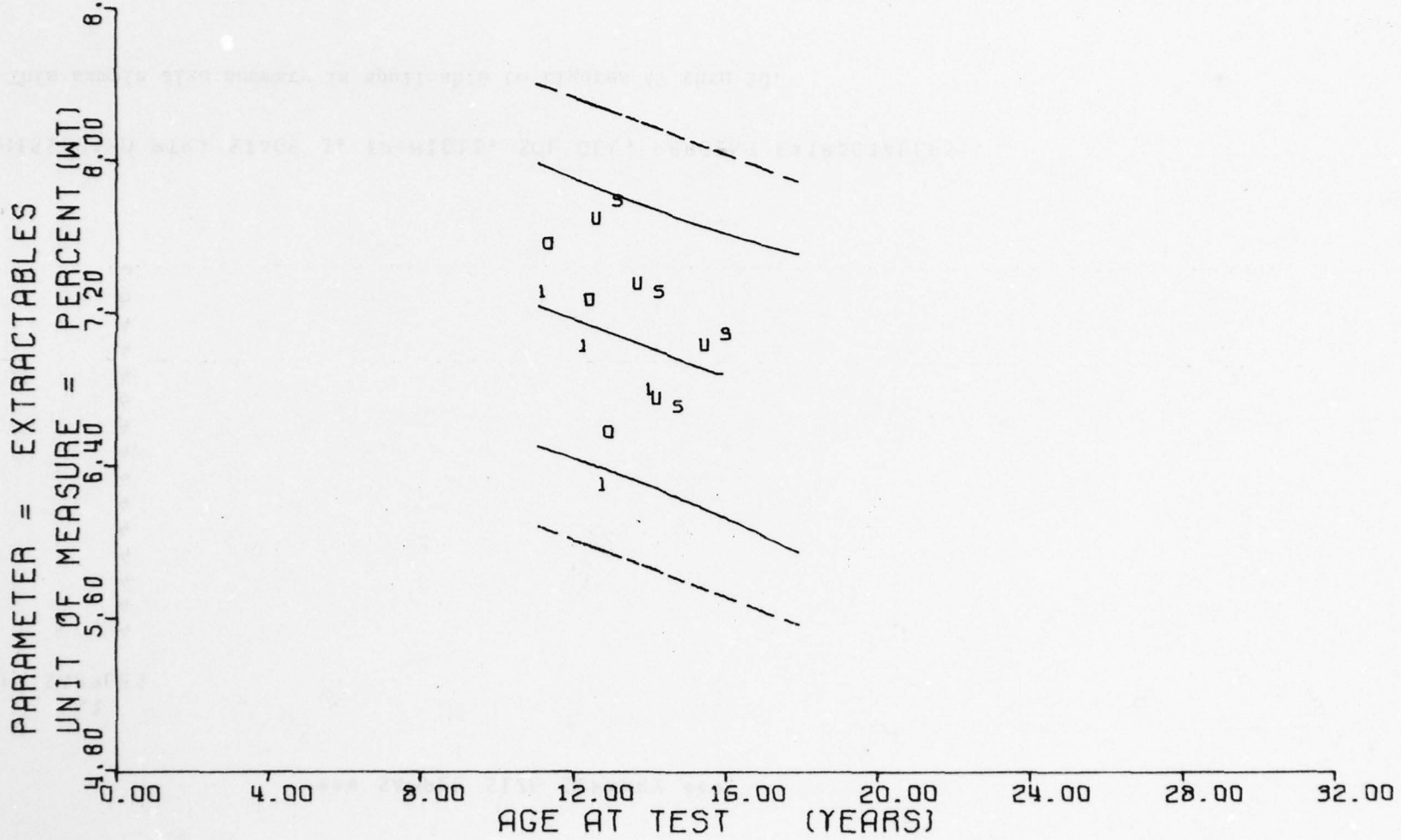
F = +4.9398380E+00 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +3.9922579E-01

R = -2.6768326E-01 SIGNIFICANCE OF R = SIGNIFICANT S_B = +2.8311394E-03

t = +2.2225746E+00 SIGNIFICANCE OF t = SIGNIFICANT S_E = +3.8765031E-01

N = 66 DEGREES OF FREEDOM = 64

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



DISSECTED MTR, STAGE 1, TP-H1011, SOL GEL, PERCENT EXTRACTABLES

Figure 47

Y = ((+4.1348895E+00) + (-2.8076343E-03) * X)

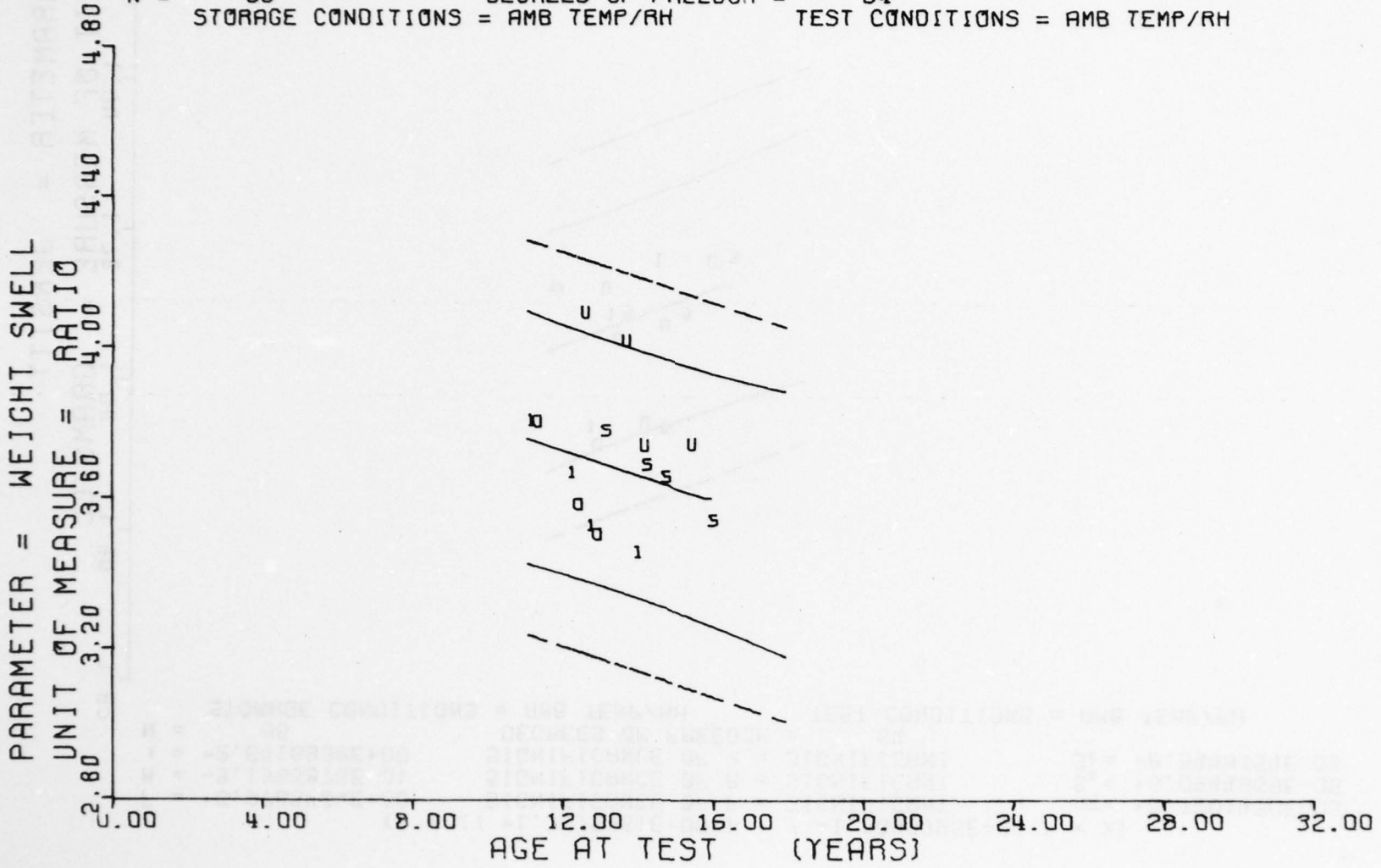
F = +4.8216692E+00 SIGNIFICANCE OF F = SIGNIFICANT σ_1 = +1.8014683E-01

R = -2.6468912E-01 SIGNIFICANCE OF R = SIGNIFICANT S_b = +1.2786210E-03

t = +2.1958299E+00 SIGNIFICANCE OF t = SIGNIFICANT S_ϵ = +1.7507362E-01

N = 66 DEGREES OF FREEDOM = 64

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



DISSECTED MTR, STAGE 1, TP-H1011, SOL GEL, WT SWELL RATIO

Figure 48

Y = ((+1.7975951E+00) + (-1.6099795E-04) * X)

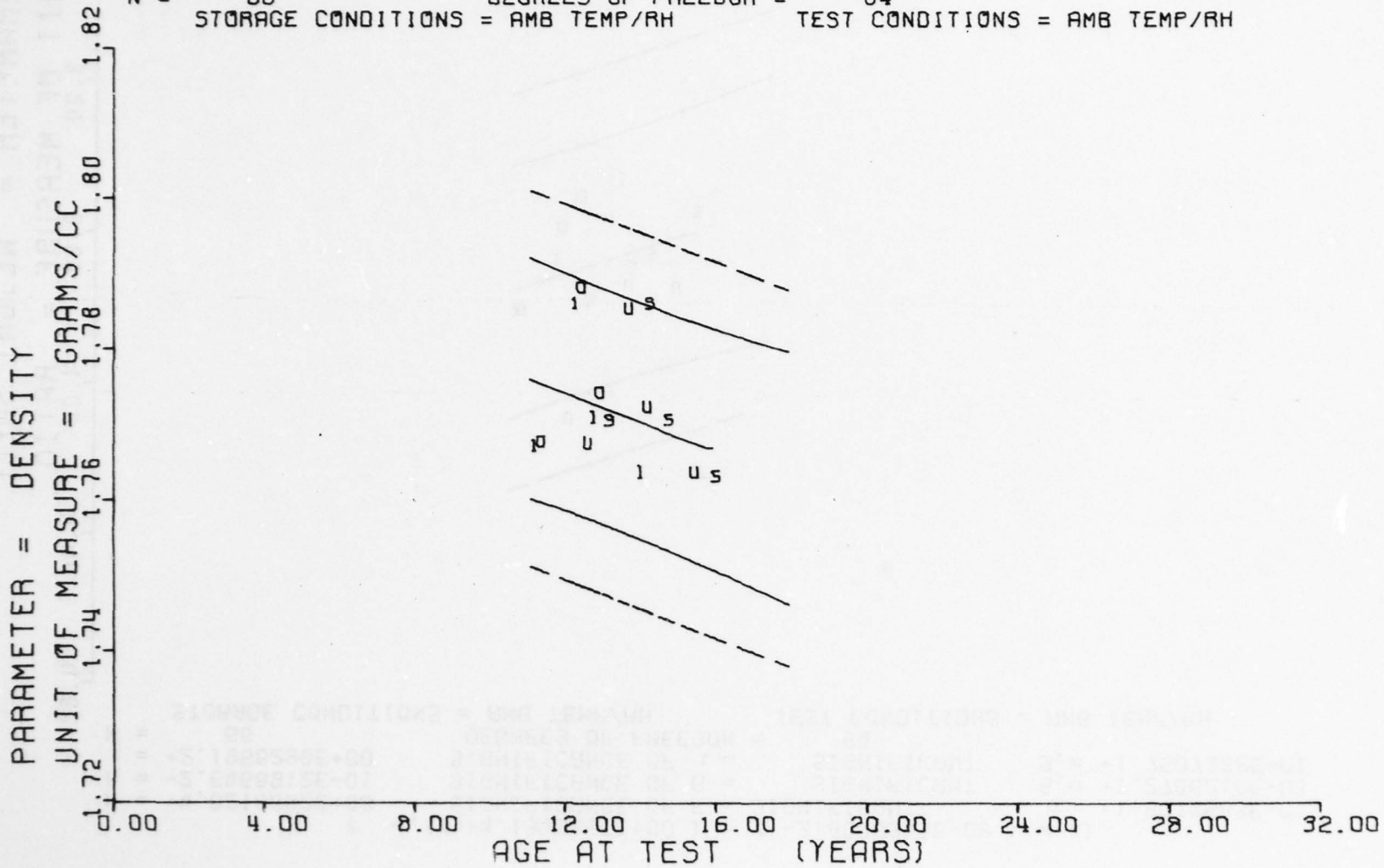
F = +6.9785464E+00 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +8.7201430E-03

R = -3.1355875E-01 SIGNIFICANCE OF R = SIGNIFICANT S_b = +6.0944969E-05

t = +2.6416938E+00 SIGNIFICANCE OF t = SIGNIFICANT S_E = +8.3448154E-03

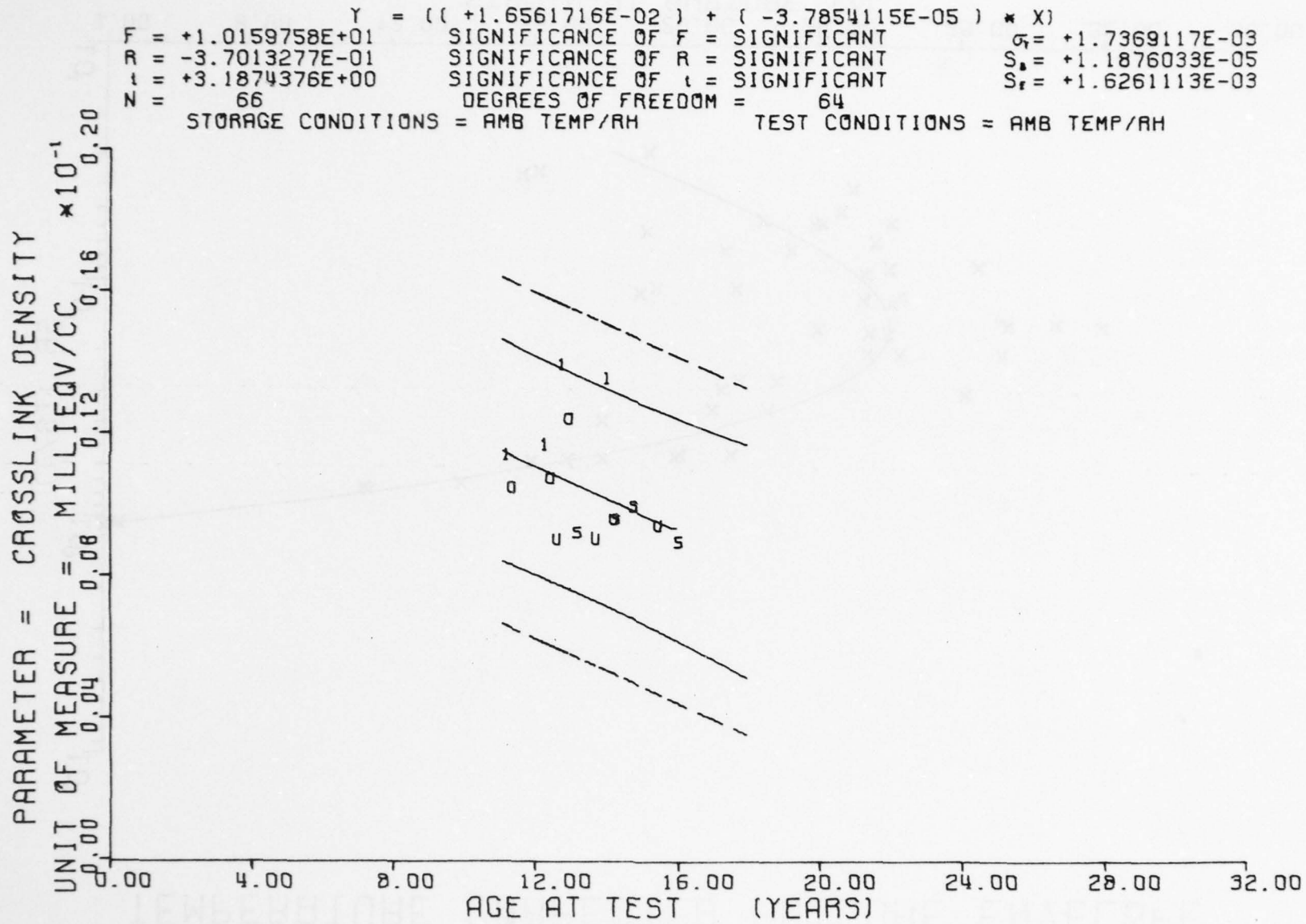
N = 66 DEGREES OF FREEDOM = 64

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



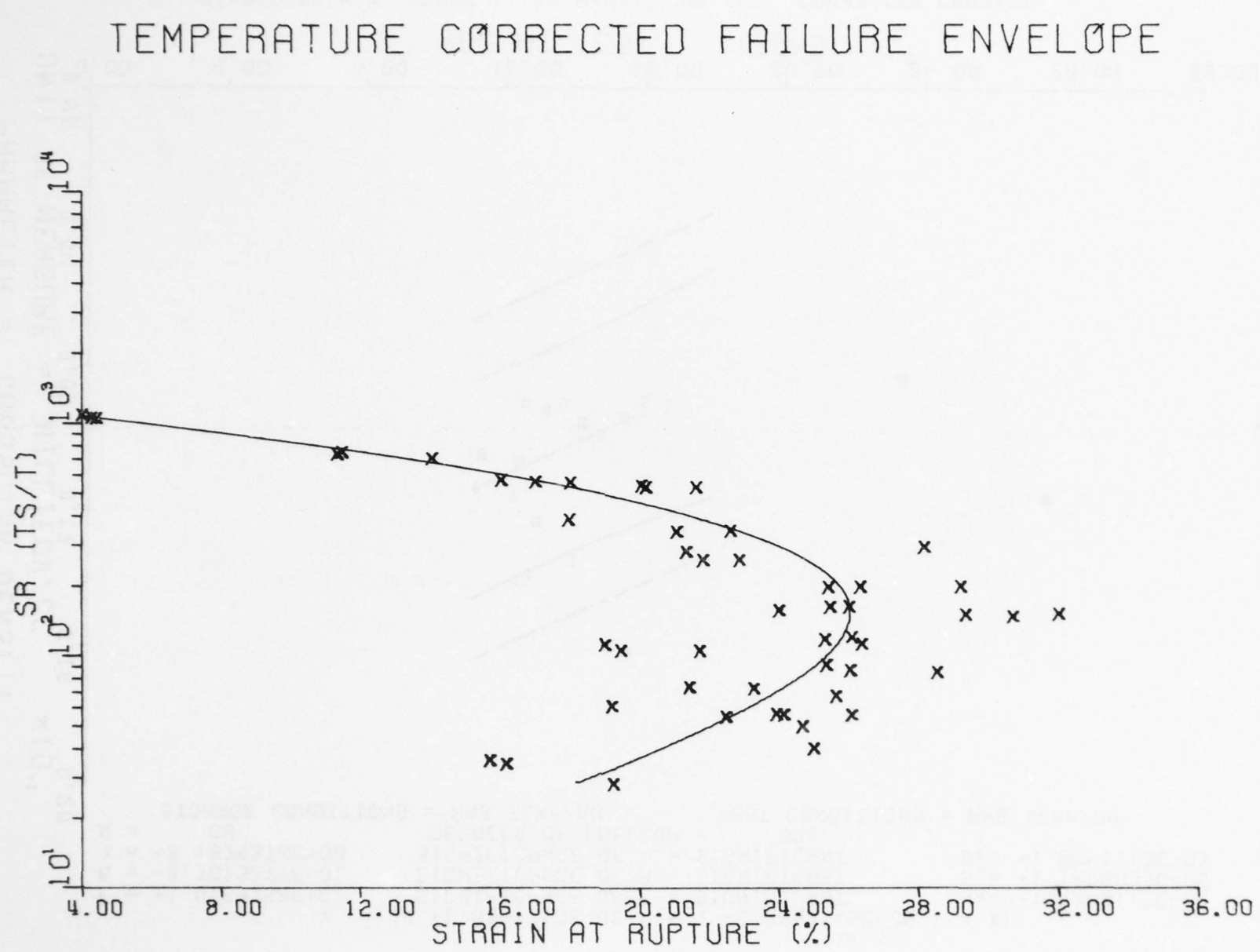
DISSECTED MTR, STAGE 1, TP-H1011, SOL GEL, DENSITY

Figure 49



DISSECTED MTR, STAGE 1, TP-H1011, SOL GEL, CROSSLINK DENSITY

Figure 50



FAILURE ENVELOPE (MOTOR/SN 0012099) DISSECTED MOTOR, STAGE I, TP-H1011

Figure 51

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4. TITLE *(and Subtitle)* Minuteman Stage I Dissected Motor Program		5. TYPE OF REPORT & PERIOD COVERED Test Results - Semi Annual 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) John A. Thompson		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Propellant Lab Section Directorate of Maintenance 00-ALC Hill AFB, UT 84406		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS MMWRM Project M82934C- WNL 17514
11. CONTROLLING OFFICE NAME AND ADDRESS Service Engineering Division Directorate of Materiel Management 00-ALC Hill AFB, UT 84406		12. REPORT DATE November 1978 13. NUMBER OF PAGES 97
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

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18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Minuteman
Solid Propellant

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Testing was performed to determine the useful shelf/service life for LGM-30 Stage I Rocket Motors. A three year storage program for propellant and components was started in May 1961. This program was then extended to a ten year study and later continued indefinitely to assure that a deterioration in motor physical characteristics could be detected in time to take some corrective actions before the weapon system performance deteriorated below an acceptable level. →

(over)

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

AD-A063 122 OGDEN AIR LOGISTICS CENTER HILL AFB UTAH PROPELLANT L--ETC F/G 21/9.2
SURVEILLANCE REPORT. STAGE I DISSECTED MOTORS. PHASE X. PROPELL--ETC(U)
NOV 78 J A THOMPSON

UNCLASSIFIED MANCP-406(74) NL

2 OF 2
AD
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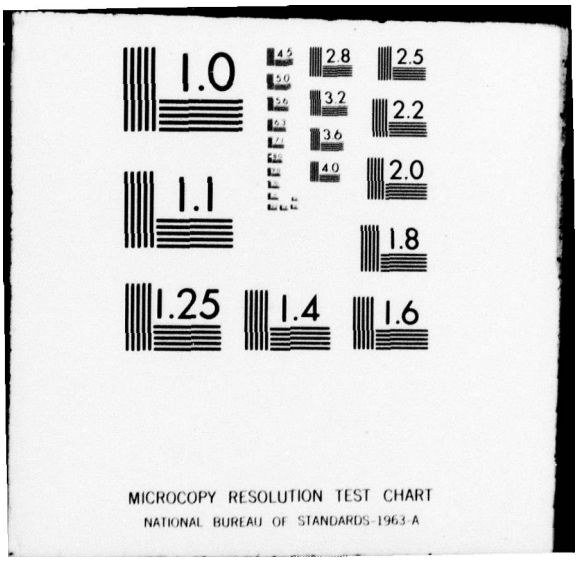
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

This report covers only propellant data and limited case bond data. The malfunction of an environmental chamber destroyed component samples that had originally been part of this testing program (and the inadvertent burning of some motors during dissection reduced the material available for testing). Planned dissection of selected motors in the future will provide samples for continued component testing. Test specimens for this reporting period were obtained from motors STM-012, 0012099, 0012199 and UP-7775 block propellant.

Separate analyses were made on the respective motors and block propellant for the second time in this report and are shown in the regressions. The plotting symbols for each motor and block propellant are listed in the statistical analyses section.

The data from this test period was combined with data from previous testing and entered into the G085 computer for storage, analysis, and regression analysis. From the statistical analysis of all data tested to date, significant degradation of the propellant does not appear likely for at least two years past the oldest data point.

Future testing will be conducted on dissected motors.